American Machinist / Metalworking Manufacturing

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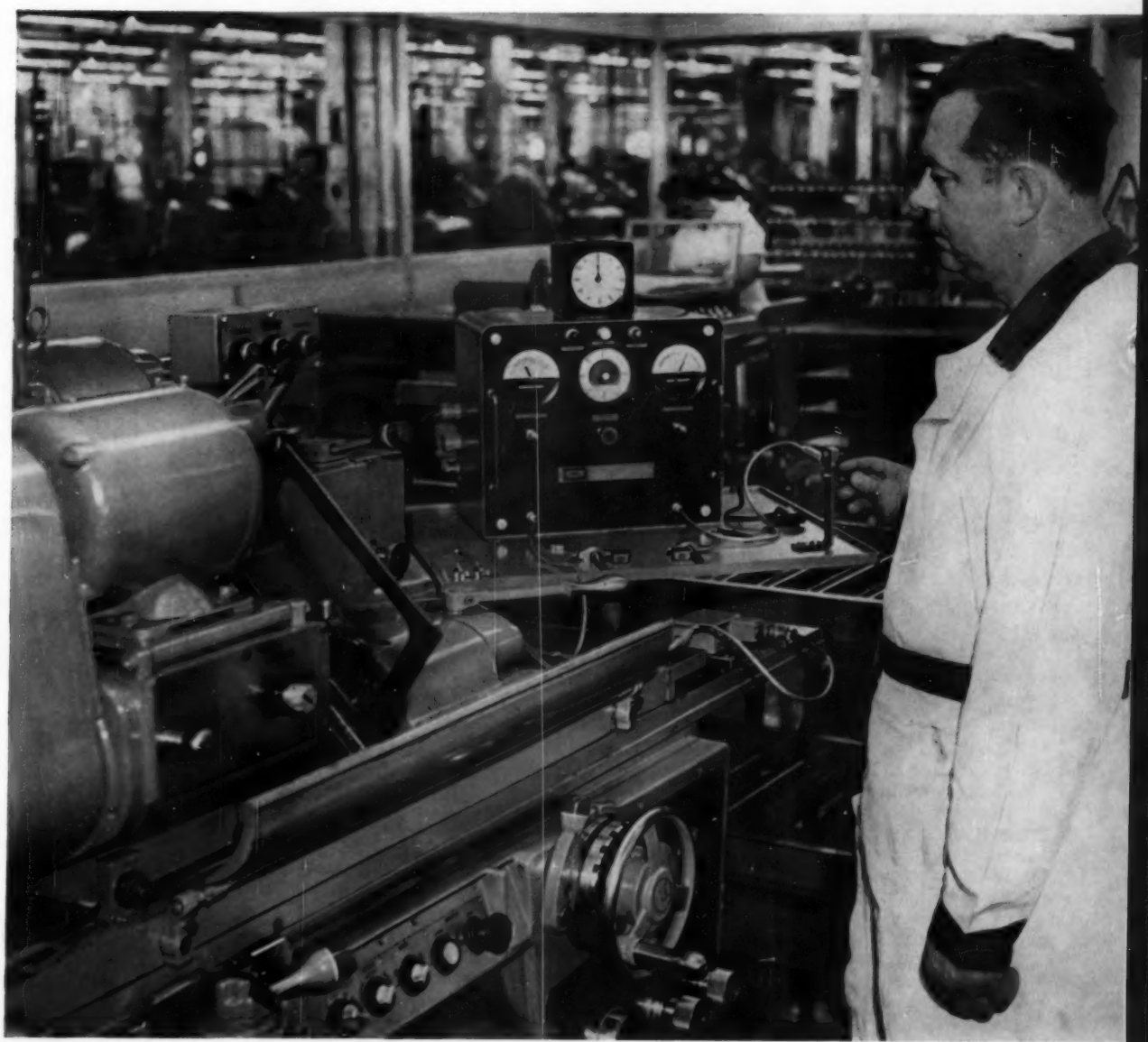
NOVEMBER 28, 1960

Special Report:

Production Lines for Job Shops



Match grinding to millionths in minutes—see page 142

- **Scrap honeycomb builds light, strong tools,** page 137
- **New uses for plastic tooling,** page 154

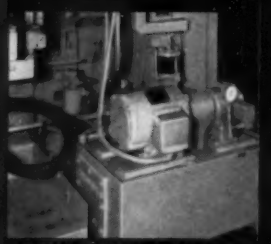
NEW Model 322-A Bore-Matic

new industry-standard design provides

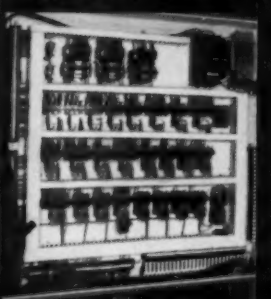
- ✓ HIGHER PRECISION
- ✓ EASIER SETUPS
- ✓ LOWER MAINTENANCE COSTS

TABLE CAMS AND SWITCHES are enclosed for protection yet easily accessible for adjustment.

STANDARD SOLENOID VALVES are externally mounted, oil immersed and individually replaceable.



EXTERNAL HYDRAULIC POWER UNIT keeps accuracy-destroying heat out of the base, is readily accessible and isolates pump and motor vibration from the machine.



ELECTRICAL CONTROLS are centralized in an easily accessible dust-tight cabinet at the rear of the machine.

Completely new from base to bridge, this double-end Bore-Matic meets all JIC standards—gives you new precision and economy for high production Borizing of medium to large size work.

Hydraulic valves and power unit are outside of the base, preventing thermal distortion, providing maximum accessibility and contributing to sustained high precision. Control valves, mounted on hydraulic manifold plates at each end of the machine, are of standard, interchangeable design, easily accessible and individually replaceable. Bridge setbacks are infinitely adjustable on slotted pads, permitting optimum relationship between work and tooling. And a full-length table pad increases the capacity of the machine.

For complete information on all the time-saving, labor-saving features of this versatile new machine, just call your Heald engineer, or send for Bulletin No: 2-322A.

PRECISION ROTARY INDEXING FIXTURE.

Shown on the machine above is a new electronically-controlled rotary indexing fixture, adjustable for any desired number of equally-spaced indexes from 4 to 500,000, permitting precision drilling or boring of accurately-spaced holes on one or more bolt circles. Holes with the same spacing are Borized in a fully automatic cycle, resetting the controls only when spacing is changed.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

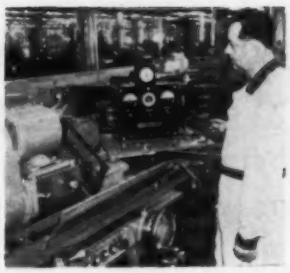
Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

HEALD®

CIRCLE 246 READER SERVICE CARD

COVER:
Match grinding to millionths on a Cincinnati cylindrical grinder at American Bosch-Arma. See page 142.



American Machinist / Metalworking Manufacturing

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TURN PAGE FOR METALWORKING REPORT ⟶

METALWORKING REPORT . . .

. . . what's new and significant in manufacturing techniques and materials— direct from our own staff and round-the-world news bureaus

CUTTING . . . Hydrostatic mounts for workhead spindles developed at GM Tech Center are used on precision grinders at New Departure Div. Dumbbell-shaped center section of spindle is supported between opposed hemishperes of housing on thin film of oil under pressure. Displacement of spindle increases oil pressure to resist the displacement. For another type of hydrostatic spindle see AM/MM--Sept 19 '60, p114. Other developments at New Departure; page 146.

INSPECTION . . . "Perfect" defects are the object of small steel castings American Brake Shoe Co will pour for the US Navy. Each must have only one flaw, and that must be typical. These will be radiographed to be included in a manual covering acceptance standards for airframe and missile castings. Standards now available only cover sections thicker than 0.75 in.; the new series will cover down to 0.13-in. thicknesses in 6x8-in. rectangles.

WELDING . . . Stainless powder brazes honeycomb at Boeing (Seattle) to improve capillary action and hold more of the brazing alloy to the top skin instead of letting it drain down through the honeycomb. The result is larger fillets and more secure joints at the top. Boeing also reports that lateral flow of filler metal on both top and bottom honeycomb surfaces can be eliminated by controlling absolute pressure in the brazing retort.

MATERIALS & COMPONENTS . . . Unique on-off magnetic properties are characteristic of a new brittle manganese compound reported by duPont. Control is by heat, where the material is magnetic at or above a certain temperature, non-magnetic below. This dividing point can be adjusted several hundred degrees by varying the composition. The compound is chromium manganese antimonide.

FORMING . . . Die reworking with plastics can save 80% in costs, according to General Electric's experience with plastic tooling. On one forming die, the springback had to be changed, so the punch was ground off, and the die was undercut, then resurfaced with epoxy. The cost comparison with standard methods was $35 vs $175. For other examples in the GE plastic-tooling program, see p154.

MATERIALS & COMPONENTS . . . Steel spring drives a small clutch coupling in one direction; freewheels in the other. In the driving direction, the spring tightens, builds up torque, and engages with slight backlash and no slip. In overrunning direction, the spring unwinds slightly, allowing the hubs to slip with respect to each other. International Mechanisms stocks sizes from 1/8 to 1 in.

FORMING . . . Shearing attachment on a press brake is installed at General Electric Co, Evendale, Ohio, to cut 3/8- to 3/4-in. stainless steel and up to 1-in. mild steel. The Pacific press brake operates half the time as a brake to form jet-engine parts. The attachment may be installed and removed rapidly with a jack-type conveyor table. While the shearing attachment is in place, forming can be done with a horn at the left end of the press.

MANUFACTURING CONTROL . . . How about an objective safety rating for your plant? National Safety Council has just announced a new formula: $R = 100 - (K \times N \times E)/A$, where K is a handicap factor depending on the type of work being done. For assembly, K is 2; for CI machining it is 1; and for steel machining it is 1.25. Thus, multiply K by the number of demerits during the period of safety infractions, then by the number of employees; divide by the thousands of sq ft of floor space, and subtract the result from 100.

FORMING . . . Ceramic liners for centrifugal-casting flasks improve the accuracy and lower the cost of special-size pipe and tube. The liners themselves are centrifugally cast inside standard metal flasks to produce the required pipe OD. American Cast Iron Pipe Co says this leaves fine ceramic particles at the liner ID, producing accuracy and good finish. After water is drained and the ceramic fired, metal is centrifugally cast to any required ID and OD in 20-ft lengths.

MATERIALS HANDLING . . . Storage without aisles is an idea from Sweden that puts shelf-storage units on tracks so they can readily be moved to close up or open up aisles between units. Each shelf unit rests on track wheels, which are powered by chain drive from a large handwheel at the end of the unit. A stockman simply shifts units to create an aisle as desired between units. An overload clutch prevents crushing anything (or anyone) between as an aisle is closed up. Builder is Verkstadstekniska Ingenjorsbyran, Stockholm.

CUTTING . . . Ceramic or Ti-carbide edges bonded to Microbore cartridges can make finish-boring cuts in steel or CI, producing chips as small as a thousandth. The coefficient of friction between the ceramic or titanium-carbide cutting tip, according to tests at DeVlieg Machine Co, is so low at a feed of 0.003 ipr that light cuts can be made with little or no danger of work heating. The tipped cartridges, which provide rigidity because of the cone seat and axial locking force, withstand high surface cutting speeds and allow faster machine cycles. The tips, bonded with epoxy resin, stand speeds up to 1400 sfpm.

Coming in AM/MM

How to select an adjustable-speed drive . . .

comparing functions, ranges, and limitations of each type

METALWORKING REPORT . . .

FINISHING . . . Satin-finish nickel plating is a new announcement from Udylite Corp, Detroit. The "Satylite" process plates with a smooth, non-reflecting surface without hand polishing or buffing, though two-tone effects can be made by buffing raised surfaces. Scratch-brush finishes can be produced by working the basic metal, then plating to full depth over the scratch marks, leaving a visible texture. The finish can be chrome plated, or may be finished in copper, brass, or bronze.

FORMING . . . Combination feeder-shear for roll-forming and other machinery has been designed by Welty-Way Products, Cedar Rapids, Iowa. It cradles a 10,000-lb coil of stock up to 48 in. in diameter and electronically controls the metal to straighten, pull from the coil, level, shear to any length from 2 to 100 ft, and feed into the fabricating equipment. Production increases of 50% are forecast.

HEAT TREATING . . . Faster vacuum annealing for stainless steel, nickel, and other alloys is expected with a German furnace being installed (after modification) by Technalloy Co, Rahns, Pa. Built by Gloh-potfactory Unna, West Germany, the furnace has thin double walls with a partial vacuum between, instead of conventional 3/4-in. walls This means less metal to be heated, faster heating, less gas consumption.

MATERIALS & COMPONENTS . . . Inconel will be the recording medium for instruments in jet aircraft under test because it will not be destroyed by fire. A stylus indicates speed, oil pressure, and such on foil 0.001 in. thick, which moves at 12 in./hr--replacing paper as for standard instrument recording. Techalloy Co, Rahns, Pa, is rolling the foil on a Sendzimir mill to an edge tolerance of 0.005 in. so the strip records without appreciable error.

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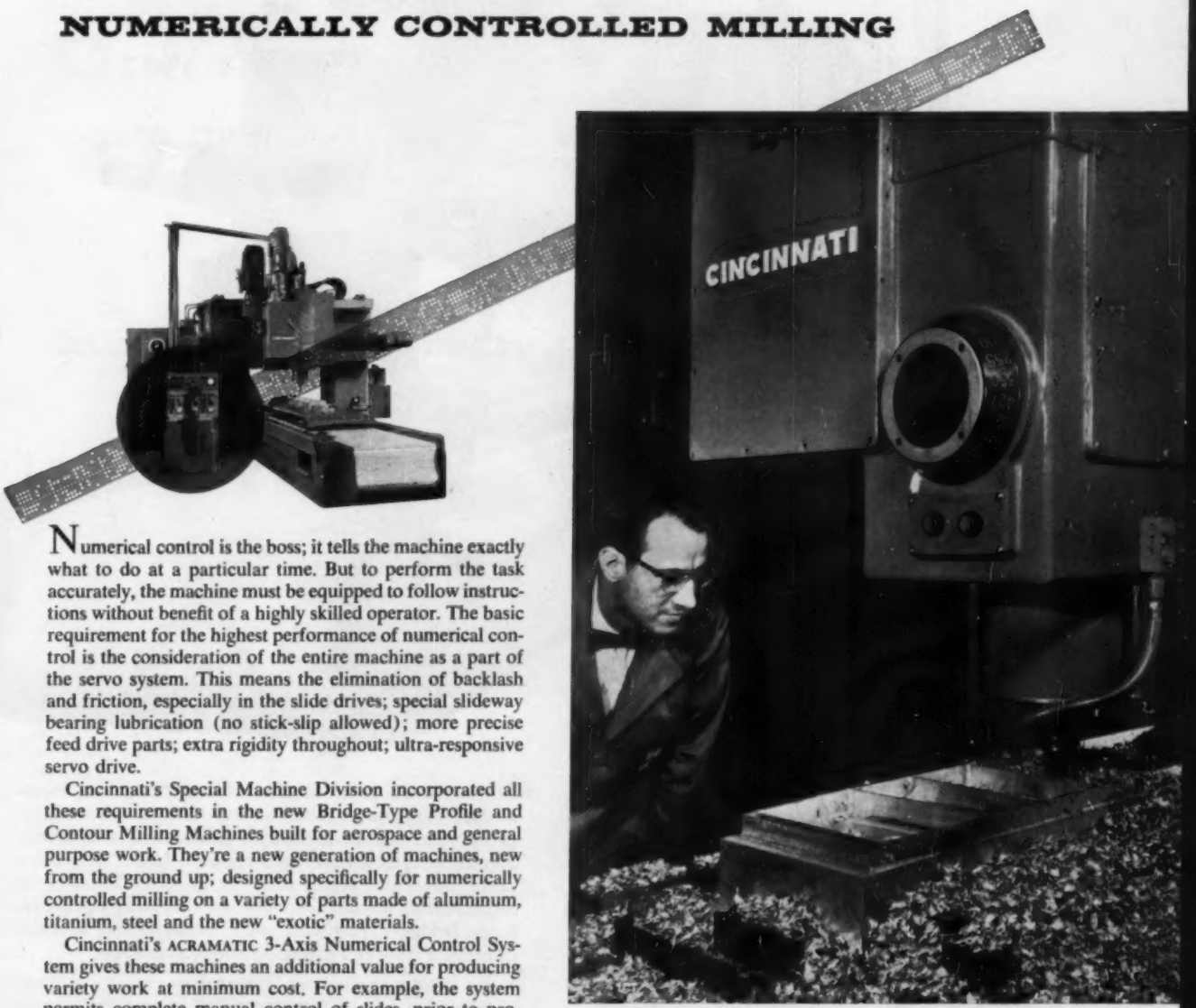
CINCINNATI

A New Generation of Machines

built by CINCINNATI Special Machine Division

. . . has everything required for

NUMERICALLY CONTROLLED MILLING



Numerically controlled milling of an aircraft wing inner panel beam on a new CINCINNATI Bridge-Type Profile and Contour Milling Machine.

Numerical control is the boss; it tells the machine exactly what to do at a particular time. But to perform the task accurately, the machine must be equipped to follow instructions without benefit of a highly skilled operator. The basic requirement for the highest performance of numerical control is the consideration of the entire machine as a part of the servo system. This means the elimination of backlash and friction, especially in the slide drives; special slideway bearing lubrication (no stick-slip allowed); more precise feed drive parts; extra rigidity throughout; ultra-responsive servo drive.

Cincinnati's Special Machine Division incorporated all these requirements in the new Bridge-Type Profile and Contour Milling Machines built for aerospace and general purpose work. They're a new generation of machines, new from the ground up; designed specifically for numerically controlled milling on a variety of parts made of aluminum, titanium, steel and the new "exotic" materials.

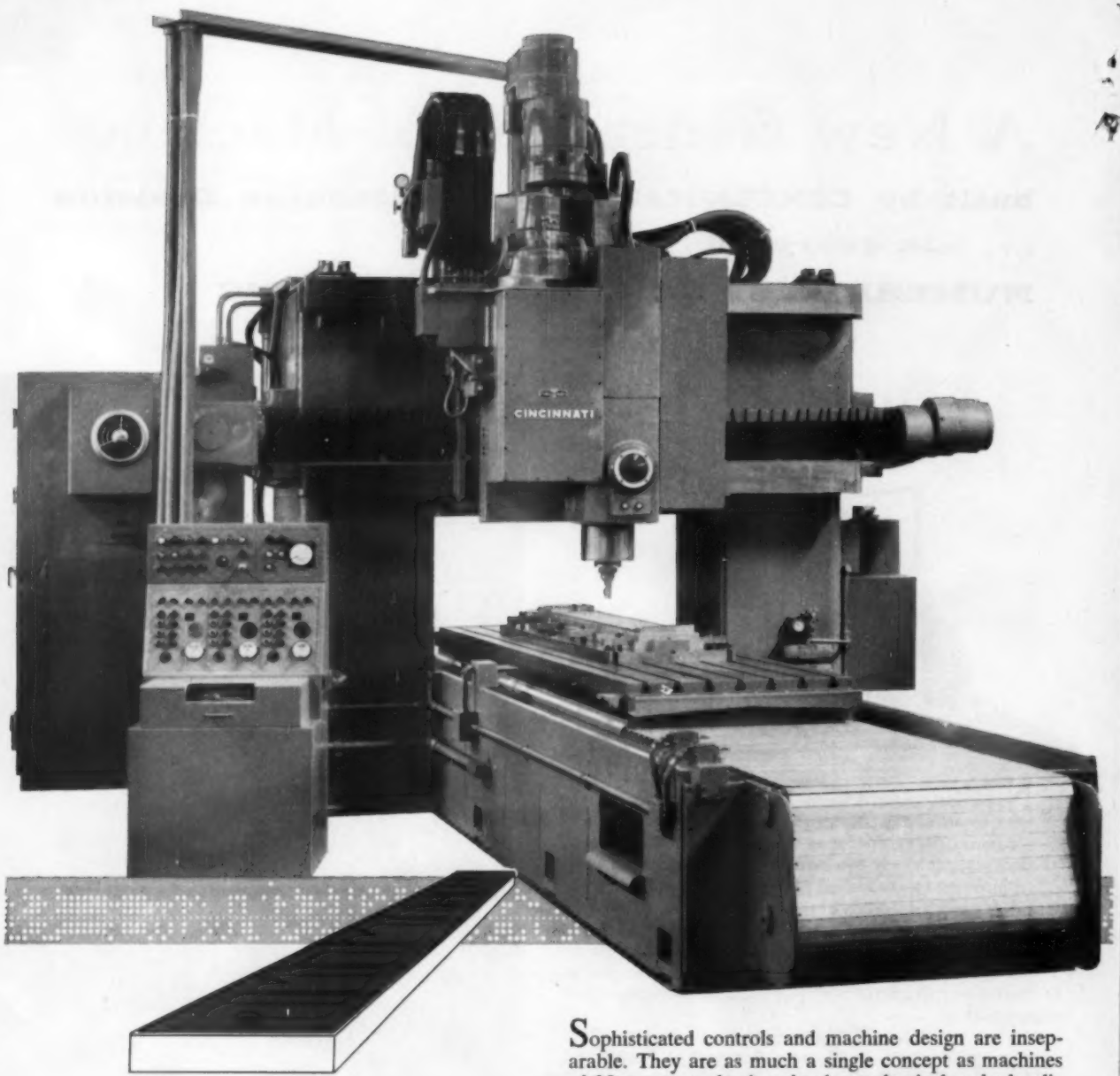
Cincinnati's ACRAMATIC 3-Axis Numerical Control System gives these machines an additional value for producing variety work at minimum cost. For example, the system permits complete manual control of slides, prior to program control, with finger-tip actuated calibrated Telephase handwheels . . . feed rate override ranges from 0 to 100% of programmed feed . . . *exclusive* cutter diameter compensation, an NC must, eliminates reprogramming for cutters of varying OD.

The machine and controls are engineered and built as an integrated unit under one roof; one responsibility. You will find more details of these fine CINCINNATI Numerically Controlled Milling Machines on the two pages following. **Special Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

CINCINNATI®

SPECIAL MACHINE DIVISION

SPECIAL MACHINES
VERTICAL AND HORIZONTAL BROACHING MACHINES
COMPLETELY AUTOMATED PRODUCTION LINES



Designed for numerically controlled milling. ACRAMATIC 3-Axis Numerical Contouring System commands this new CINCINNATI 36"x120" Bridge-Type Profile and Contour Milling Machine. The part is an aircraft wing panel beam. This machine is one of several built to perform a variety of milling operations.

Sophisticated controls and machine design are inseparable. They are as much a single concept as machines of 30 years ago having simple mechanical or hydraulic automatic cycles. Cincinnati's Special Machine Division keeps this close relationship by skillfully blending all requirements for ultra-modern metalworking equipment in the Bridge-Type Profile and Contour Milling Machine illustrated above. Feature-advantages include:

Extra rigidity throughout, inherent in closed cantilever construction, assures full potential of ACRAMATIC Numerical Control System.

Constant speed hydraulic motor drive for the spindle. Provides full torque throughout entire range of speeds.

DESIGNERS AND BUILDERS OF SPECIAL MACHINES • VERTICAL AND HORIZONTAL BROACHING

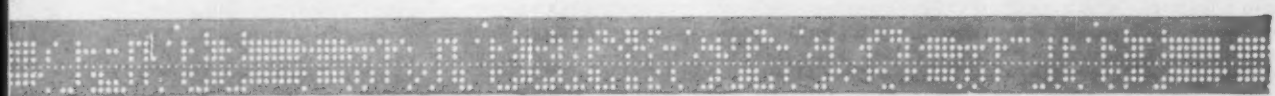
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

CIRCLE 250 READER SERVICE CARD

CINCINNATI SPECIAL MACHINE DIVISION gives you

coordinated design

in new Numerically Controlled Milling Machine



Wide range of spindle speeds (in 24 or 26 steps) and feeds (¼ to 100 ipm), allowing complete freedom in changing from one basic metal to another.

"Building Block" construction gives you a choice of several table widths and any practical table travel starting at 48".

ACRAMATIC Numerical Control with its absolute measuring system (a product of Cincinnati's CIMTROL Division) is incorporated in this machine to give you the advantage of feed rate override from 0 up to 100% of programmed feed . . . complete manual control of slides with Telephase remote control handwheels . . . absolute readout to .001" . . . discretionary exit from programmed path at any point, and automatic push-button realignment at exactly the same point.

The above features are vital to efficient, *practical* use of numerically controlled contour milling. Those that are operator oriented, such as feed rate override and automatic cutter diameter compensation, may be blocked out by the programmer.

Every type of equipment built by Cincinnati Milling's Special Machine Division is considered as a completely coordinated production unit capable of reducing costs, machining an "impossible" job and/or improving quality. Our specialists want to know about your problems. May we hear from you?

MACHINES • COMPLETELY AUTOMATED PRODUCTION LINES

CINCINNATI®
SPECIAL MACHINE DIVISION

CIRCLE 251 READER SERVICE CARD

how's this for high-speed hobbing?

WORK PIECE					HOB (1 start)				Pieces per Load	Method*	Time per Piece	Pieces per Grind	Cut
Dia. Pitch	No. of Teeth	Helix Angle	Face Width	Material	Dia.	RPM	Feet PM	Feed					
10	20	15°	1¾"	1040 leaded	3"	500	395	.055"	1	A	2 min. 25 sec.	150	Finish
7	23	13°	¾"	8620	4"	350	370	.100"	2	A and B	59 sec.	240	Pre-shave
5	43	24°	1⅝"	8620	4"	280	300	.100"	2	B	3 min. 45 sec.	80	Pre-shave

** Method A: Diagonal Hobbing. Method B: Step-by-step Hobbing.*

This is the kind of performance you get with

THE FELLOWS-PFAUTER P400 HIGH-SPEED HOBBING MACHINE

HIGH-SPEED HOBBING. Performance speaks louder than words. The examples given above show the results of high-speed hobbing which can cut costs. The figures are taken from the records of typical production runs on the Fellows-Pfauter P400.

DESIGN. The P400 was designed for High-Speed Hobbing, and it features a new basic design. The individual machine elements are of maximum rigidity. The hob head is heavy and rugged, the machine column and bed are of double-wall construction with heavy V-ways and the work table is as large as the maximum permissible work piece diameter. The index worm gear is nearly as large as the work table, and the work support column is of massive construction. All parts of the machine are properly proportioned and of sturdy design to eliminate vibration. The cost is more than justified by the resulting reductions in hobbing times and the increased hob life.

RIGIDITY and CLOSE TOLERANCES. The large size work table and index worm gear and the oversize hob head, which eliminates lead errors caused by hob breakout, are important factors in providing the rigidity necessary to hold work to close tolerances.

COMPLETELY OPEN WORKING AREA. The machine and the work-support columns are of such rigid construction that the hobbing stresses are absorbed without requiring an over-arm. Therefore the working area is easily accessible for set-up and work loading. The automatic retraction of the table from the hob also facilitates changing of work.

SET-UP TIMES and FLOOR-TO-FLOOR TIMES are reduced on the P400 because it has infinitely variable speeds and feeds, rapid traverses for all machine movements, including hob shifting manually by push button, and built-in hydraulics for the operation of the tailstock and simple hydraulic fixtures used on this machine.

AUTOMATION on the P400 is simple and fast. The illustrations show a machine equipped with automatic loading and unloading devices.

GEAR HOBBING COSTS can be cut by high-speed hobbing on a P400 because of the resulting savings in production time, floor space, maintenance and labor.

THE PRECISION LINE

THE FELLOWS GEAR SHAPER COMPANY 78 River Street, Springfield, Vermont, U.S.A.

Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
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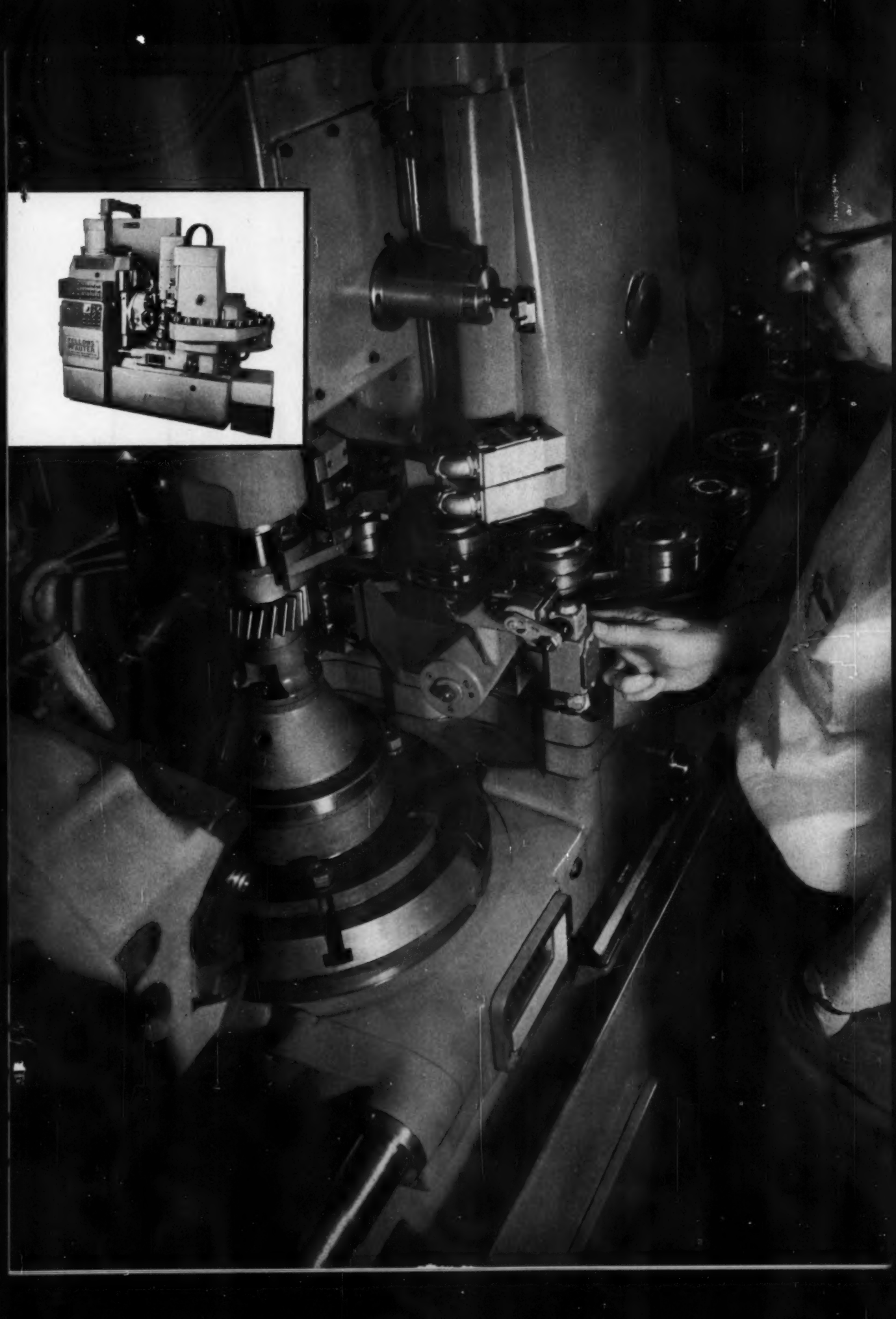
Fellows *Gear Production Equipment*



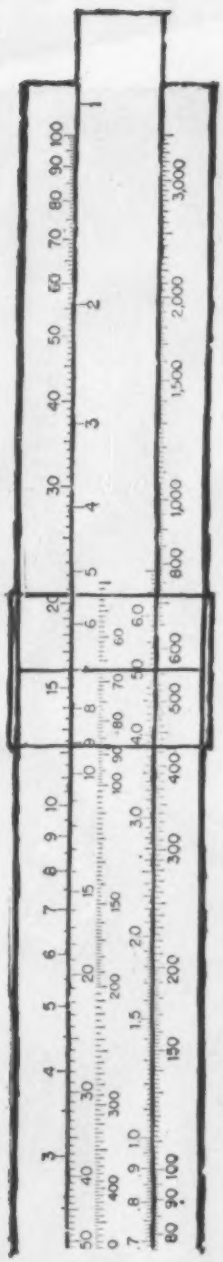
most threading jobs should be **ENGINEERED**

More and more people are realizing the great advantages in production, time saved and increased profits from running a threading operation that is properly engineered.

For instance, Landis engineers recently obtained the utmost in threading efficiency by advising the replacement of a machine of another make with a LAN-NU-ROL Thread Rolling Machine in threading job lots of 1 to 1000 studs at the General Electric Plant in Lynchburg, Va. Besides improving thread quality, all sizes and diameters were rolled on the LAN-NU-ROL. The exclusion of several operations and equipment plus eliminating the need for purchasing certain sizes of pre-threaded bar stock were important cost-saving advantages.

But this is only one of the many hundreds of threading operations throughout the country benefiting from the results of Landis engineering. Advice on thread design, the proper threading method to use, the proper threading equipment to use, and the development of special tooling, fixtures, or equipment for unusual operations are among the services offered.

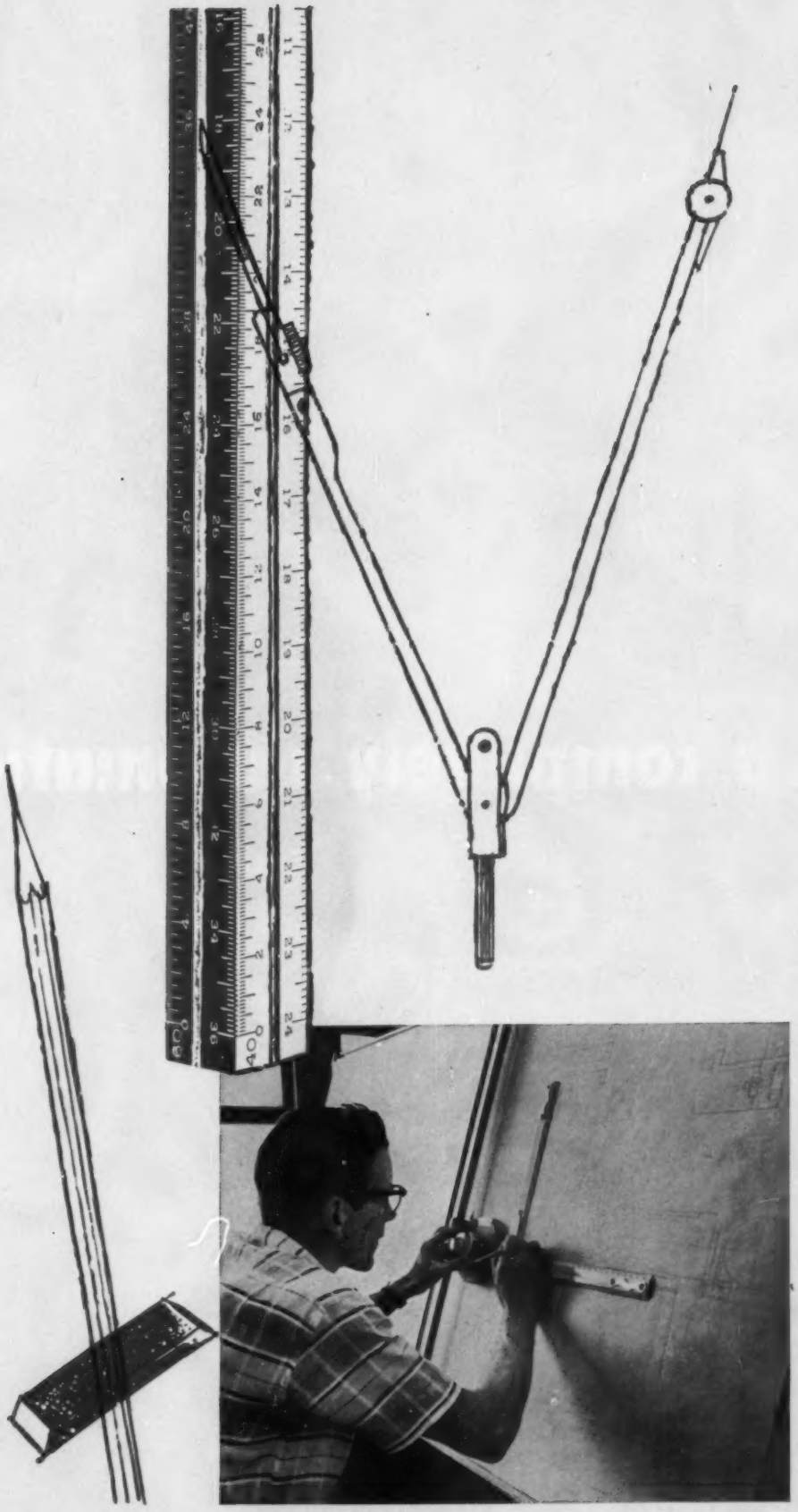
Won't you take advantage of our Engineering Services? Whether the method of thread generation is Cutting, Rolling, Tapping or Grinding Landis engineers are ready to assist you.



LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA

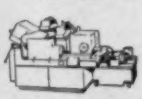
THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT



Threading Machines

Die Heads
Rotary & Stationary

Taps—Collapsible
& Solid Adjustable



Centerless Thread
Grinding Machines

Thread Rolling
Tools

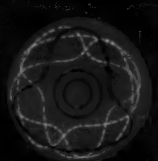
Thread Rolling
Machines

592C

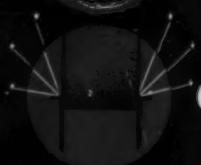
NOW...a completely automatic

indexing crank grinder

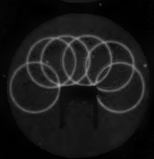
outstanding all NEW features



automatic indexing *'on the fly'*



automatic locating for side wall grind



automatic rotary diamond wheel dressing

automatic Microfeed®

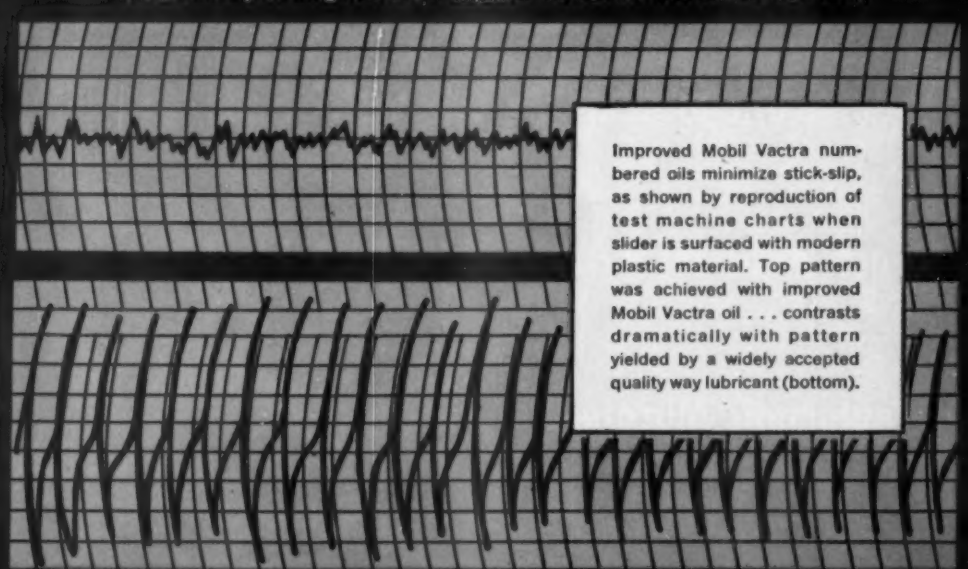
LANDIS

world leader in precision grinders

LANDIS TOOL COMPANY, WAYNESBORO, PA.

NOW! WAY LUBRICANTS WITH ALL SIX

Stick-slip tester developed by Mobil's research laboratories closely simulates operating conditions of today's machine tools . . . records stick-slip electronically as weighted slider is pulled across lubricated cast iron bed.



Improved Mobil Vactra numbered oils minimize stick-slip, as shown by reproduction of test machine charts when slider is surfaced with modern plastic material. Top pattern was achieved with improved Mobil Vactra oil . . . contrasts dramatically with pattern yielded by a widely accepted quality way lubricant (bottom).

QUALITIES REQUIRED BY TODAY'S MACHINE TOOLS!

IMPROVED MOBIL VACTRA Nos. 1·2·3·4

Excellent for all way systems, all way surfaces, all operating conditions!

To meet the diverse requirements of today's complex machine tools, way lubricants must function effectively under a variety of operating conditions . . . must possess not one or two, but *six* important capabilities.

Now you can get all six—with Improved Mobil Vactra® oils Nos. 1-4, inclusive!

These improved Mobil Vactra oils provide these advantages: • Minimum stick-slip on all types of ways—steel, cast iron or plastic. • Control of table "float" through correct viscosity—without risk of film failure and wear. • Protection against way scoring through controlled EP qualities. • Prevention of lubricant filter clogging. • Protection against rust and corrosion. • Stability under all normal operating conditions.

Improved Mobil Vactra oils Nos. 1-4 offer these benefits:

- **Increased Machine Availability,** because less downtime is required for adjustments...especially significant with today's high overhead and burden rates.
- **Fewer Rejects,** through greater precision and better finishes . . . vitally important with today's closer tolerances and the high cost of finished pieces.
- **Minimum Maintenance Costs,** through effective protection of critical way surfaces.

Available in four viscosities, Improved Mobil Vactra numbered oils permit the selection of a grade exactly suited to any critical operating condition. For complete details, call your Mobil Representative or use the coupon below.

Mobil

MOBIL OIL COMPANY
150 East 42nd Street
New York 17, N. Y.

Mobil Oil Company
Room 2057-A
150 East 42nd Street
New York 17, N. Y.

Gentlemen: I am interested in using Mobil Vactra Nos. 1-4 to help alleviate way lubrication problems at my plant.

*Name*_____

*Position*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

◀ CIRCLE 258 READER SERVICE CARD

CIRCLE 259 READER SERVICE CARD

Fine tools that encourage Good Work

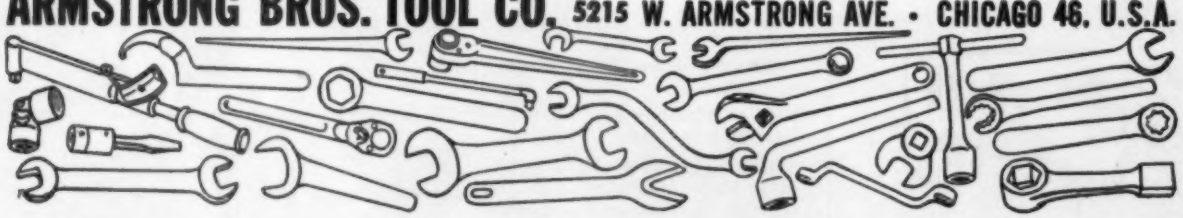
ARMSTRONG WRENCHES

An ARMSTRONG Wrench feels right—is balanced. It goes over nuts or screw heads easily, grips firmly without sloppiness, won't round corners—because openings are carefully machined to correct sizes. It's safe, strong beyond need without clumsy bulk—because of superior design and selected steels, heat treated to proper degree of hardness and tensile strength. It's quality finished, ARMALOY (alloy steel) Wrenches in chrome plate with heads buffed; HI-TEN (carbon steel) Wrenches in baked-on gray enamel with heads ground bright . . . all plainly marked for size. All are uniformly excellent tools manufactured under strict quality control, by modern methods, with modern equipment in a modern tool plant . . . 1537 different industrial sizes and types—single wrenches, or sets in metal cases, boxes or rolls . . . each a quality tool. Armstrong Wrenches are "Fine tools that encourage good work."

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

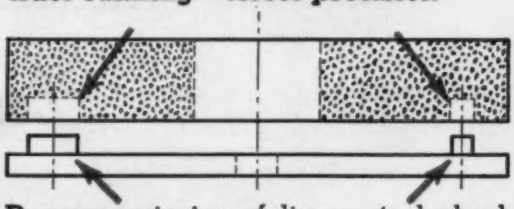
If you don't know your local ARMSTRONG Distributor, we will send you the names of those in your area.

ARMSTRONG BROS. TOOL CO. 5215 W. ARMSTRONG AVE. · CHICAGO 46, U.S.A.



Gardner disc features add safety... improve accuracy

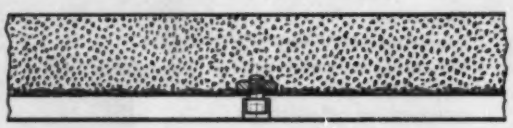
Gardner TRU-LOK® disc mounting
truer running—closer precision



Proper centering of disc on steel wheel assured by Tru-Lok.

Greater accuracy—Tru-Lok eliminates run-out and vibration caused by off center mounting.

Gardner WIRE-LOKT® construction
maximum safety—maximum economy



Full value—the entire rated thickness of the abrasive is usable.

Safety—heavy, imbedded steel mesh assures maximum safety.

Call the man who can give you the *most* in practical, cost saving help with your flat surface grinding . . . your Gardner Abrasives Specialist.

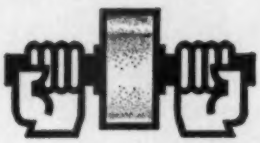
GARDNER

abrasive discs

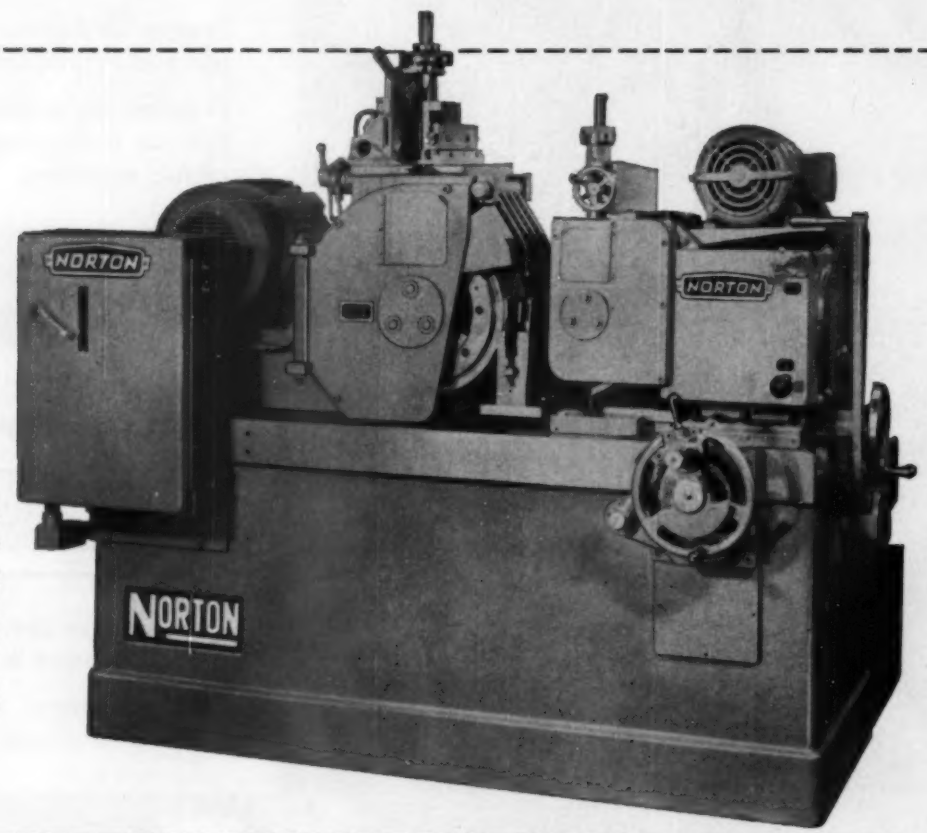
BELOIT, WISCONSIN

Newest NORTON Grinder!

The No. 2 Straddle-Bearing

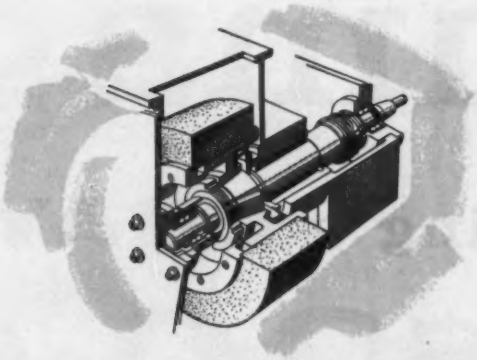


Centerless is built for speed . . .



Ready for Immediate Delivery
The new Norton No. 2 Centerless Grinder can be arranged for full automatic, semi-automatic or manual thru-feed or plunge grinding. Capacity includes work diameters ranging from 1/16" to 4¾" depending on type of work rest and bar grinding fixture.

3 MAJOR ADVANCEMENTS IN CENTERLESS GRINDING



Straddle-Bearing Spindle Support, in both grinding and regulating wheels, provides extra strength. Combined with the inherent rigidity of Norton spindles this boosts capacity to take heaviest cutting pressures, while permitting fast grinding to close tolerances under all conditions.

accuracy . . . economy

Like all Norton grinders and lappers the Norton No. 2 *Straddle-Bearing* Centerless Grinder is built to deliver "Touch of Gold" performance — the Norton extra that adds value to your product while cutting your production costs.

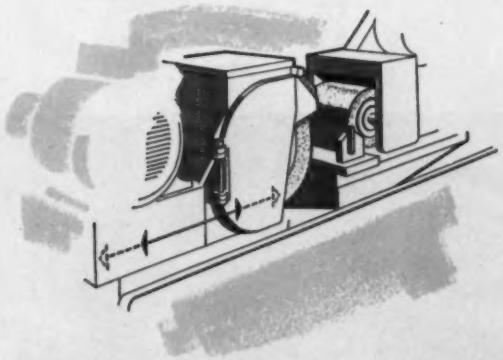
You'll find plenty of proof of that in the modern construction of this newest machine of its type. *Straddle* support of spindle bearings adds strength and ability to take tough jobs . . . the mobile wheel head and constant work-loading alignment make jobs shorter and easier.

Many other features result in outstanding performance advantages. Call your Norton Sales Engineer, a trained expert in the grinding field, for consultation on how these features can benefit your production. Or write for Catalog 1328. NORTON COMPANY, Machine Division, Worcester 6, Mass.

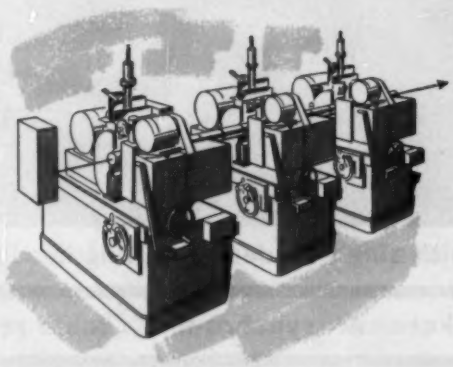
NORTON

GRINDERS and LAPPERS

District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co. Ltd., Toronto 5.



Mobile Grinding Wheel Head, with wheel mounted between head ways and feed screw located beneath wheel center for ideal balance, provides instant response to signals. This results in especially fast sizing, one of many important advantages over fixed head operation.



Work Loading Alignment is never disturbed by wear of either grinding or regulating wheel . . . neither is the alignment of the work rest blade. Movable heads for both grinding and regulating wheels make this advantage possible . . . and especially time-saving in a battery set-up.

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

imagine

buying a GRAY planer for only

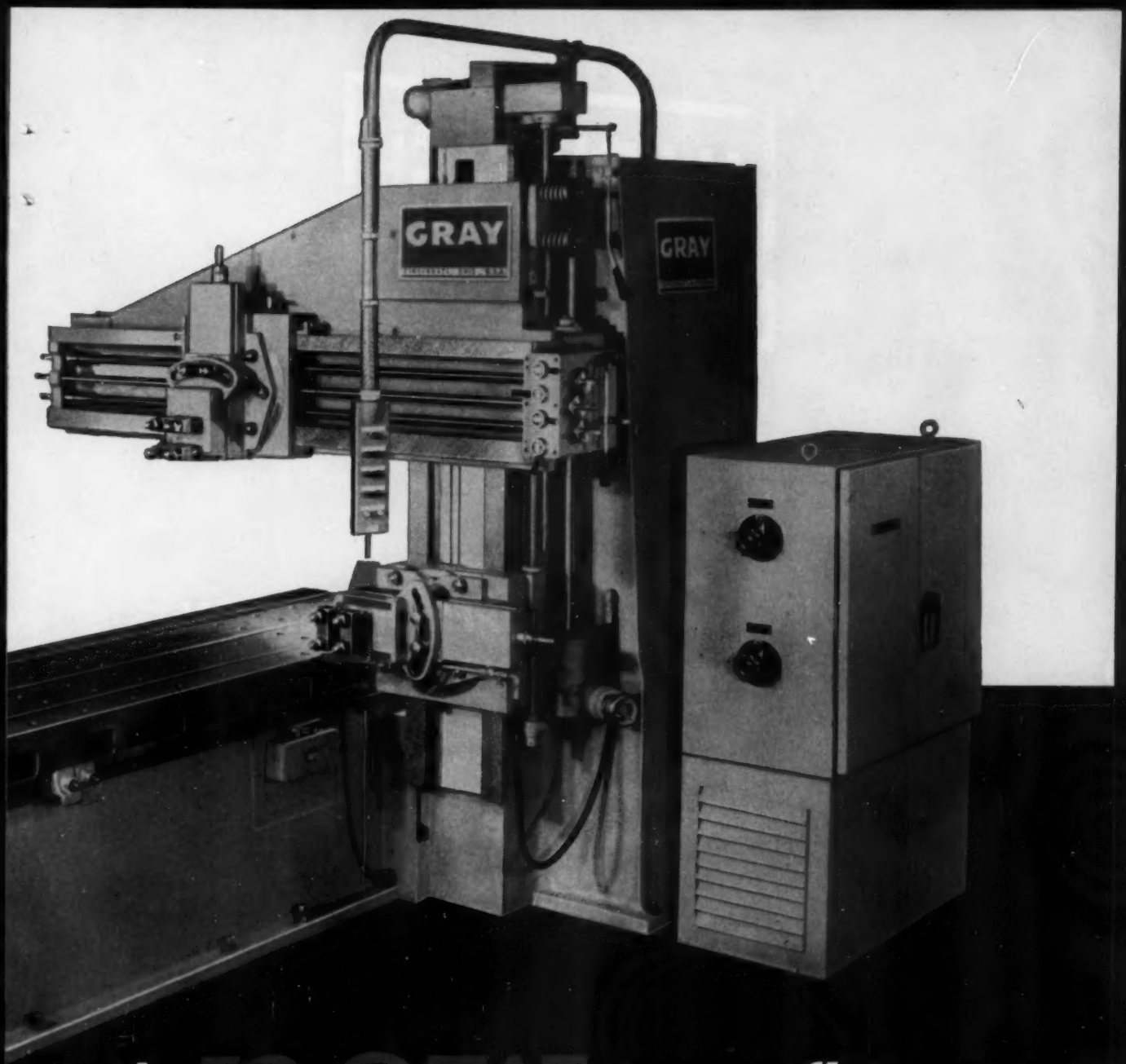
$30,660

above basic price includes 30" x 6' planer, one rail head, electric drive and controls

- available with single or double-cutting heads
- flush bottom bed
- new Gray knee
- synchro-mesh table replacer
- full pendant control of table
- Gray Safety nut
- full floating drive shaft
- quick acting saddle and slide clamps
- abutment tool aprons
- non-shock pneumatic tool lifters
- infinite feed range

technical bulletin available

CIRCLE 264 READER SERVICE CARD



the new 30"-36"-42" flying scot

■ square locked throughout ■ knee and rail counterbalance ■ pyramid side walls on bed

■ vee ways ■ gray non-metallic ways—optional ■ maximum capacity—table width

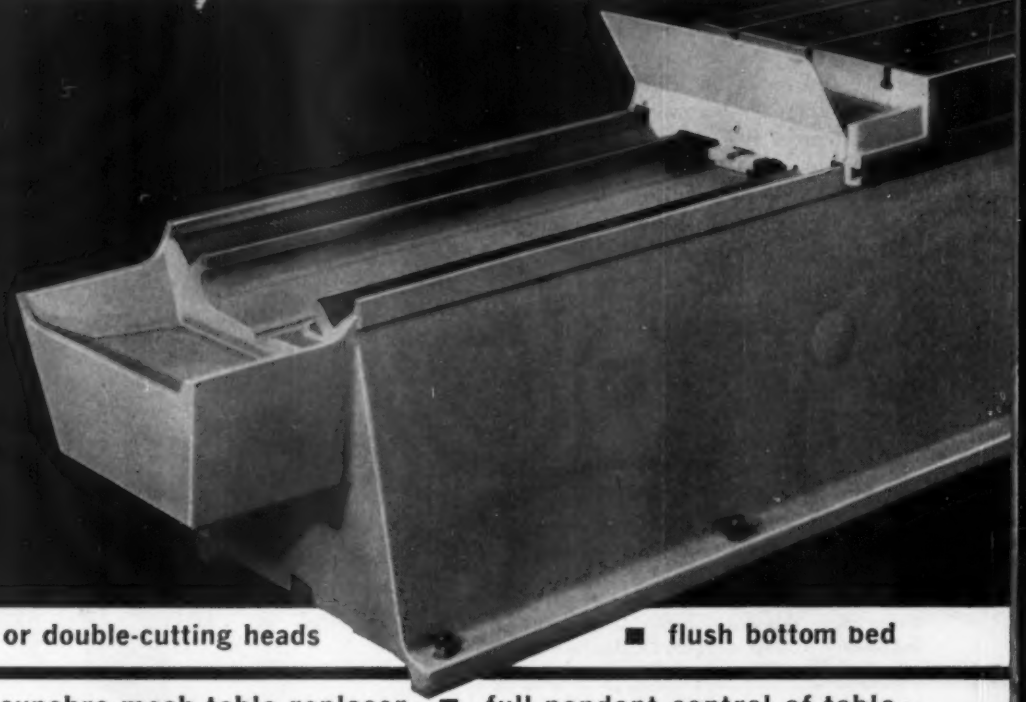
■ 'reservoil' lubrication ■ high table speeds ■ duplex tables optional ■ new column

■ helicone transmission ■ space saver drive ■ table safety stop ■ forced lubrication

horizontal milling and boring machines
planers
planer type milling machines

THE G. A. GRAY CO.
CINCINNATI, OHIO

CIRCLE 265 READER SERVICE CARD



■ available with single or double-cutting heads ■ flush bottom bed

■ new Gray knee ■ synchro-mesh table replacer ■ full pendant control of table

■ Gray Safety nut ■ full floating drive shaft ■ quick acting saddle and slide clamps

■ abutment tool aprons ■ non-shock pneumatic tool lifters ■ infinite feed range

technical bulletin available

CIRCLE 264 READER SERVICE CARD

HARDINGE
ELMIRA, N.Y.

PRODUCE MORE SUPER PRECISION PARTS AT LOWER COST

the new 30"-36"-42" flying scot

■ square locked throughout ■ knee and rail counterbalance ■ pyramid side walls on bed

■ vee ways ■ gray non-metallic ways—optional ■ maximum capacity—table width

■ 'reservoil' lubrication ■ high table speeds ■ duplex tables optional ■ new column

■ helicone transmission ■ space saver drive ■ table safety stop ■ forced lubrication

horizontal milling and boring machines
planers
planer type milling machines

THE G. A. GRAY CO.
CINCINNATI, OHIO

CIRCLE 265 READER SERVICE CARD

Blast It Better!

Add bigger savings with
ARROW-BLAST abrasive*

Pressure blasting saves you time and trouble in plenty of metal cleaning jobs.

But that's only part of the economy story.

With Norton ARROW-BLAST abrasive you get other important savings. ARROW-BLAST abrasive is composed of ALUNDUM* fused alumina grains — characteristically hard and sharp for extra fast cutting action — tough, strong and blocky for high re-

HARDINGE
ELMIRA, N.Y.

PRODUCE MORE SUPER PRECISION PARTS AT LOWER COST

with

HARDINGE HIGH SPEED
SUPER PRECISION
PRODUCTION MACHINES

and

HARDINGE HIGH SPEED
SUPER PRECISION
TOOL ROOM MACHINES

CALL THE HARDINGE SALES
ENGINEER FOR COMPLETE DETAILS

Blast It Better!

Add bigger savings with
ARROW-BLAST abrasive*

Pressure blasting saves you time and trouble in plenty of metal cleaning jobs.

But that's only part of the economy story.

With Norton ARROW-BLAST abrasive you get other important savings. ARROW-BLAST abrasive is composed of ALUNDUM* fused alumina grains — characteristically hard and sharp for extra fast cutting action — tough, strong and blocky for high resistance to breakdown.

That's how ARROW-BLAST abrasive assures longer, more useful service life and lower cleaning costs. Also, contrasted with sand-blasting, ARROW-BLAST abrasive cleaning eliminates hazards. Dust is held to a minimum, allowing maximum visibility.

For maximum savings in compression cleaning, add Norton NORBIDE* pressure blast nozzles. Molded of the man-made material that's next to diamonds in hardness, NORBIDE nozzles last longer than any other you can buy, and give exactly the type of cleaning stream you need, from broad to pencil-thin. For quick service on ARROW-BLAST abrasive and NORBIDE nozzles, see your Norton Distributor. Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade Marks Reg. U.S. Pat. Off. and Foreign Countries

NORTON
ABRASIVES

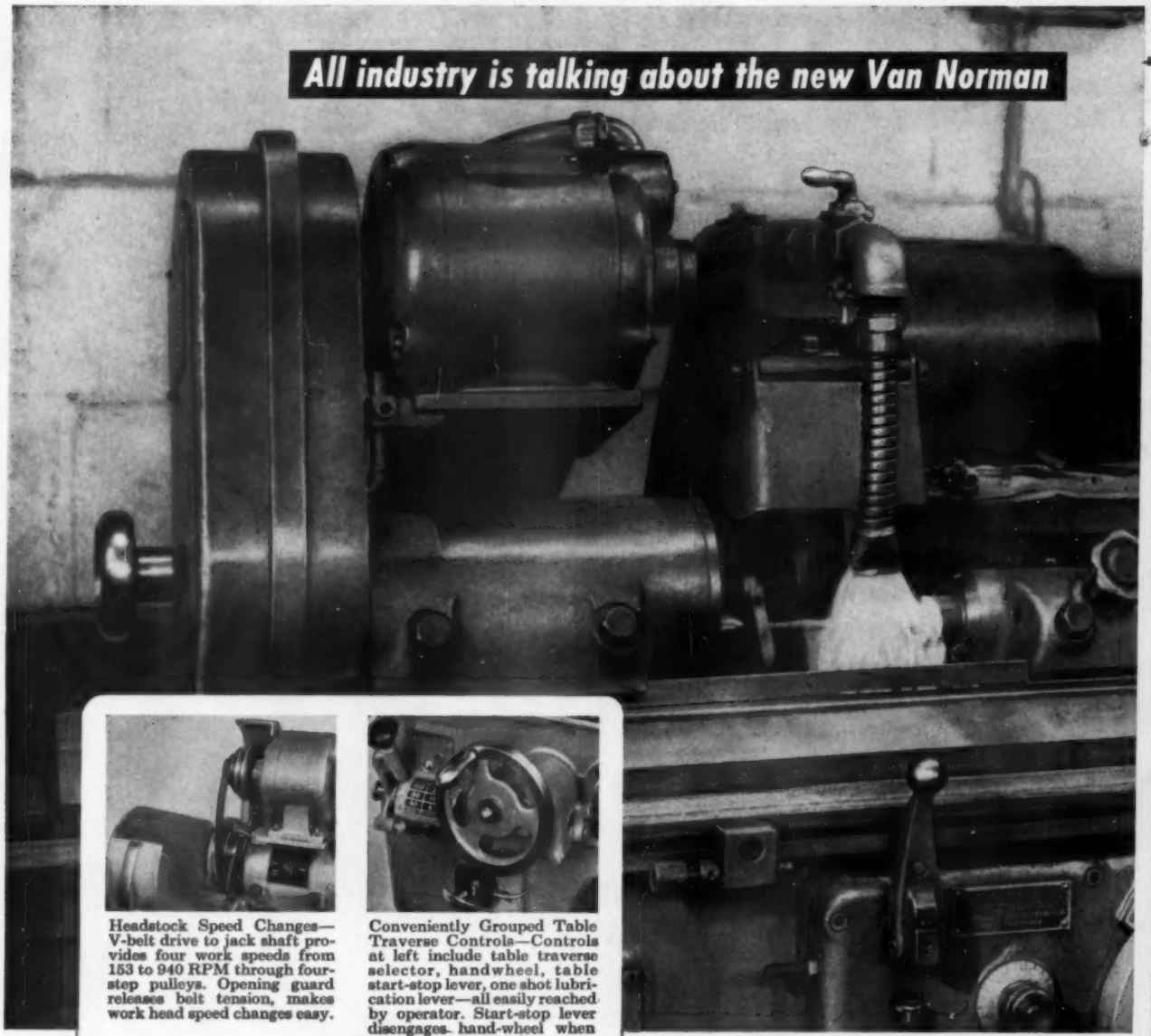
Q-402

75 years of . . . Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

◄ CIRCLE 266 READER SERVICE CARD

▲ CIRCLE 267 READER SERVICE CARD



Headstock Speed Changes—V-belt drive to jack shaft provides four work speeds from 153 to 940 RPM through four-step pulleys. Opening guard releases belt tension, makes work head speed changes easy.

Conveniently Grouped Table Traverse Controls—Controls at left include table traverse selector, handwheel, table start-stop lever, one shot lubrication lever—all easily reached by operator. Start-stop lever disengages hand-wheel when power travel is used.

K&K CUTS SMALL PART GRINDING TIME 50% ...MAINTAINS .0003 TOLERANCE

K&K Grinding Company cut small part production time in half when they switched to VN 418 Cylindrical Grinders. Specifically designed for fast precision traverse or plunge grinding of small parts, this VN machine gives repetitive accuracy and finish to small parts requiring a tolerance of .0003 or less. And it's easily changed over from one job to another.

4 Headstock Speed Changes—The VN 418 features V-belt drive to jack shaft, providing four work speeds from 153 to 940 RPM through four-step pulleys. Opening guard releases belt tension . . . makes work head speed changes easy.

Conveniently Grouped Table Traverse Controls—All controls . . . table traverse selector, handwheel, table start-

VAN NORMAN
SPRINGFIELD 7, MASSACHUSETTS

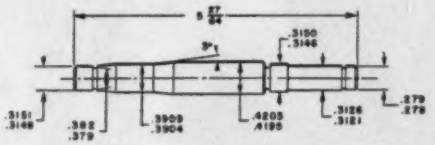
VN 418 Cylindrical Grinder doubles grinding output of plug gages and small instrument shafts... easily changed over from one job to another... assures repetitive accuracy and finish.

stop lever, one-shot lubrication lever . . . are easily reached by the operator. Start-stop lever disengages hand-wheel when power travel is used.

Get Detailed Information—Your local VN Franchised Distributor is ready to show you how the VN 418 Cylindrical Grinder can cut your production time . . . and costs. Call him *today*.

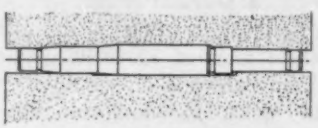
And here is a typical Van Norman centerless grinder cost-saving application

CUSTOMER'S PROBLEM:



A prominent electric motor manufacturer had the problem of reducing the cost of grinding the rotor shaft used in their small motors. They were grinding the shaft in (2) operations because they were unable to hold required tolerances when attempting to grind in one operation. Automatic loading and unloading was to be considered.

VAN NORMAN SOLUTION:



A VN DIVERSIMATIC with Automatic Loading and Unloading Device—Due to the built-in accuracy of a Van Norman Diversimatic the machine was arranged to grind the entire length of the rotor shaft in (1) operation with the machine equipped for automatic loading and unloading mechanism. The preliminary estimate was: the machine would grind 600 pieces per hour at 100% efficiency. Formerly, the top performance on this job had been 300 pieces per hour. A loading fixture capable of holding approximately 300 shafts in a magazine was designed. This was so arranged that it would load one piece at a time between the wheels, grind and eject to the back of the machine at the guaranteed rate.

THE RESULT:

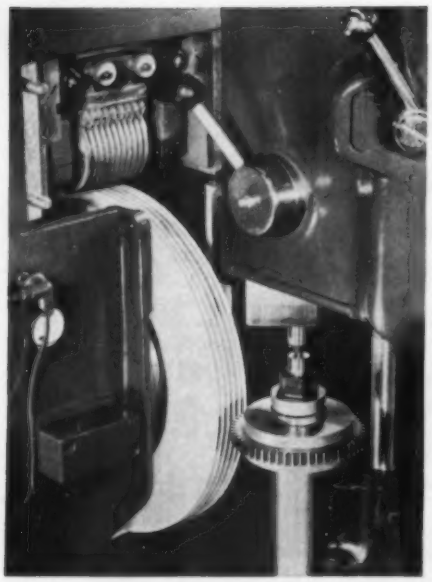
The machine produced as designed. Holding all tolerances and although customer would accept .0003 runout when part was rotated on journals, Van Norman ground in production parts with run-out not exceeding .00015. Van Norman built-in rigidity paid off again.

MACHINE COMPANY

A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED

VN

2393



precision gear floor-to-floor times CUT TO THE BONE

and scrap rate cut from 75% to 3%...

At Hughes Aircraft Co., El Segundo, California, a Sheffield Model 140 Gear Grinder produces external precision spur and helical gears of 32 to 96 diametral pitch from hardened or soft, preformed or solid blanks. Floor-to-floor times have been cut so dramatically that we've listed some of the "before" and "after" figures at the right. All of these were for gears ground from solid blanks.

Previous high scrap rate was caused by warping and distortion in heat treatment after hobbing and shaving. Most of the gears—steel, aluminum, and beryllium copper that used to break shaving cutters—are now ground with wheels dressed by the Sheffield Crushtrue® method. The grinder also makes precision class 4 master gears for Hughes, and even on small jobs is *twice* as fast as former methods.

The 140 Grinder can Crushtrue® or diamond dress wheels, handles D.P.'s from 8 to 200. Write for the full cost-saving Hughes story.

COMPARATIVE FLOOR-TO-FLOOR TIMES (minutes)

D.P.	Prec. Class	Mat'l	No. Teeth	O.D.	Face Width	BEFORE	AFTER
32	2	440C	28	.937	⅜"	11.7	5.3
32	2	440C	84	2.687	⅜"	24.7	9.8
36	2	440A	13	.437	.643	10.6	5.7
36	2	4340	94	2.667	.480	27.7	15.7
48	2	440A	56	1.328	.312	11.1	7.0
48	2	440A	62	1.500	.125	12.2	6.6
48	2	440C	96	2.042	.250	14.9	9.5
48	2	416SS	20	.458	.125	7.7	4.2
48	1	416SS	78	1.667	.125	13.2	7.6
48	1	4140	105	2.229	.125	15.8	9.2
48	2	416	100	2.500	.090	15.3	8.9
48	1 & 2	303SS	120	2.541	.125	17.2	10.1
54	2	440A	68	1.292	.145	12.6	6.3
60	2	440A	84	1.433	.187	15.3	7.2
60	2	440A	14	.279	.281	7.1	3.7
64	1	BeCu	39	.641	.067	9.1	4.1
64	1	302SS	104	1.652	.100	14.5	6.0
64	2	440C	112	1.781	.125	15.1	6.3
64	2	4130	120	1.895	.187	15.9	6.6
64	2	4140	83	1.328	.250	12.8	5.8
64	2	416 CRES	88	1.406	.050	13.2	5.6
96	2	BeCu	150	1.576	.125	18.4	7.4
96	2	BeCu	90	.951	.110	7.5	5.6

Grinding times given for 2 passes (32 thru 48 D.P.) or one pass (54 D.P. and finer).

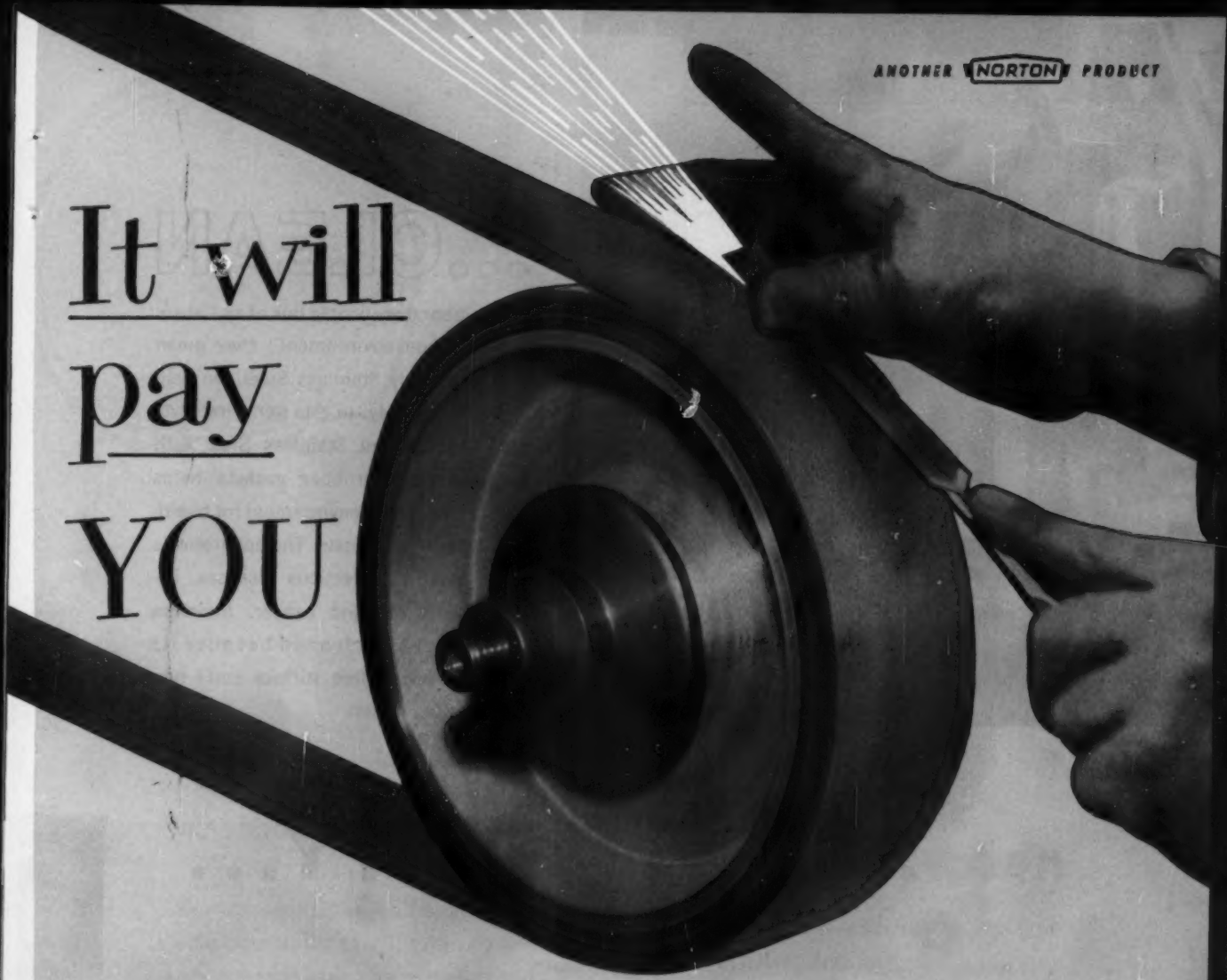
The **SHEFFIELD** *Corporation* *Dayton 1, Ohio*

A subsidiary of The Bendix Corporation

Inspection Gages, Dimensional Control Instruments, Machine Controls, Automatic Gaging & Assembly Systems, Measuray® X-Ray Thickness Measuring, Crushtrue® & Multiform® Grinders, Cavitron® Ultrasonic Machine Tools, Press-Pacer® Transfer Units, Large Dies, Tooling, Contract Manufacturing.

ANOTHER NORTON PRODUCT

It will pay YOU



...to use resin-bonded belts

HERE are the simple facts of the matter: Behr-Manning resin-bonded abrasive belts are faster cutting. Loading or shedding is at a minimum. Naturally, therefore, they last longer than glue-bond belts, and completely justify their slightly higher initial price by the production savings you enjoy.

There are two principal types of Behr-Manning resin-bonded abrasive belts:

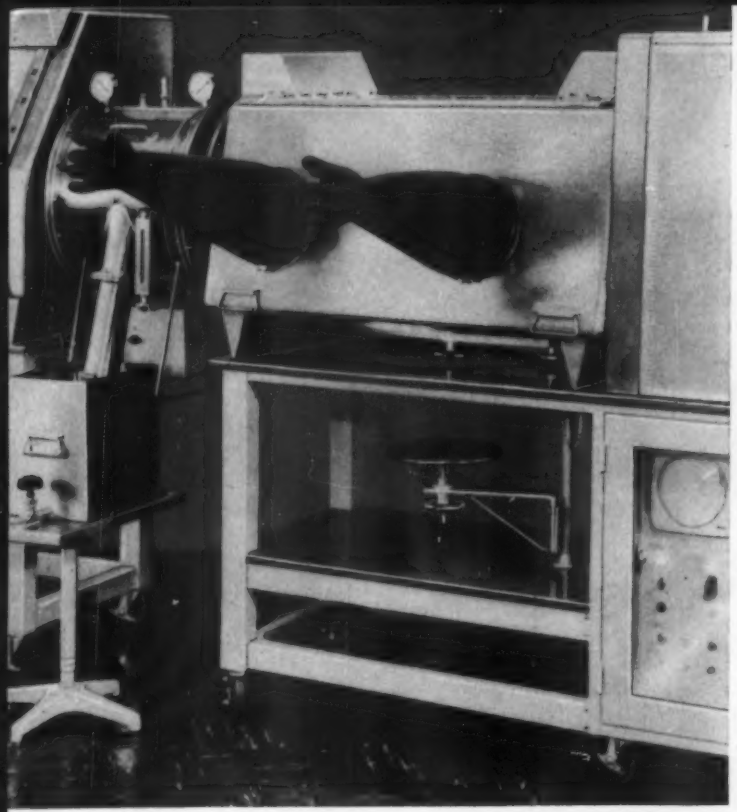
RESINALL® . . . an all resin-bonded aggressive belt of strong X-weight cloth, for maximum heat resistance in most all rough and intermediate grinding operations.

RESINIZED® . . . a resin-over-glue belt of good heat resistance, in strong X-weight for flat polishing, and in flexible J-weight for contour polishing.

Prove to your own satisfaction how resin-bonded belts will save you time and money. Ask for an in-plant demonstration. Write Dept. AM-11. BEHR-MANNING Co., Troy, N. Y., a division of Norton Company.

BEAR BRAND Abrasives

CIRCLE 271 READER SERVICE CARD



...CLEAN

When laboratory people talk of an "absolutely sterile environment" they mean just that. Only Stainless Steel can help make it that way. In this germ-free system, spot-welded Stainless Steel with molded silicone-rubber gaskets helps maintain a sterile environment for breeding germ-free animals. The apparatus is used to study infectious diseases, immunochemistry and cancer. Stainless Steel is easily cleaned because its smooth, pocket-free surface can't harbor contamination.

DIRTY...

Few things are dirtier than wet coal fines. And corrosive. The combination of moisture and sulfur eats away most materials in nothing flat. Not Stainless Steel. Stainless has exceptional corrosion resistance to anything that can happen in coal or ore processing. Screens, chutes and other handling equipment are easily fabricated from Stainless Steel. Stainless even has what they call "slideability"; its smooth surface prevents build-up and clogging. And it lasts up to 10 times longer than other materials.

USS Stainless Steels... no other metal makes such a material difference in so many applications

This mark tells you a product is made of modern, dependable Steel

. . . and in between

No material can match Stainless Steel's versatility. Stainless Steel offers designers and fabricators a unique combination of properties: superior strength, extraordinary corrosion resistance to an enormous variety of reagents, outstanding high temperature properties, and excellent appearance. It is easily fabricated and, because Stainless Steel lasts longer, actually costs less in the long run. If you have a selection or delivery problem, ask your USS representative or nearest steel service center.

USS is a registered trademark

USS

United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
National Tube—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

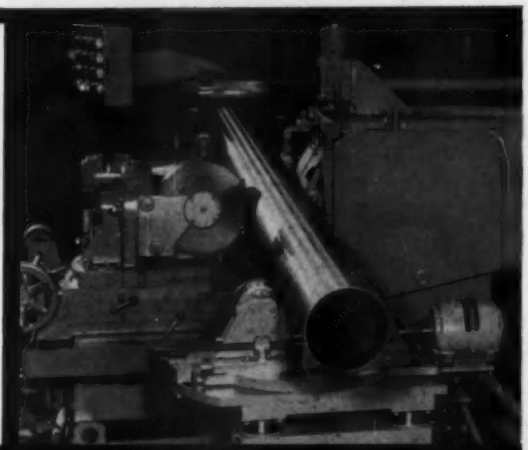
United States Steel

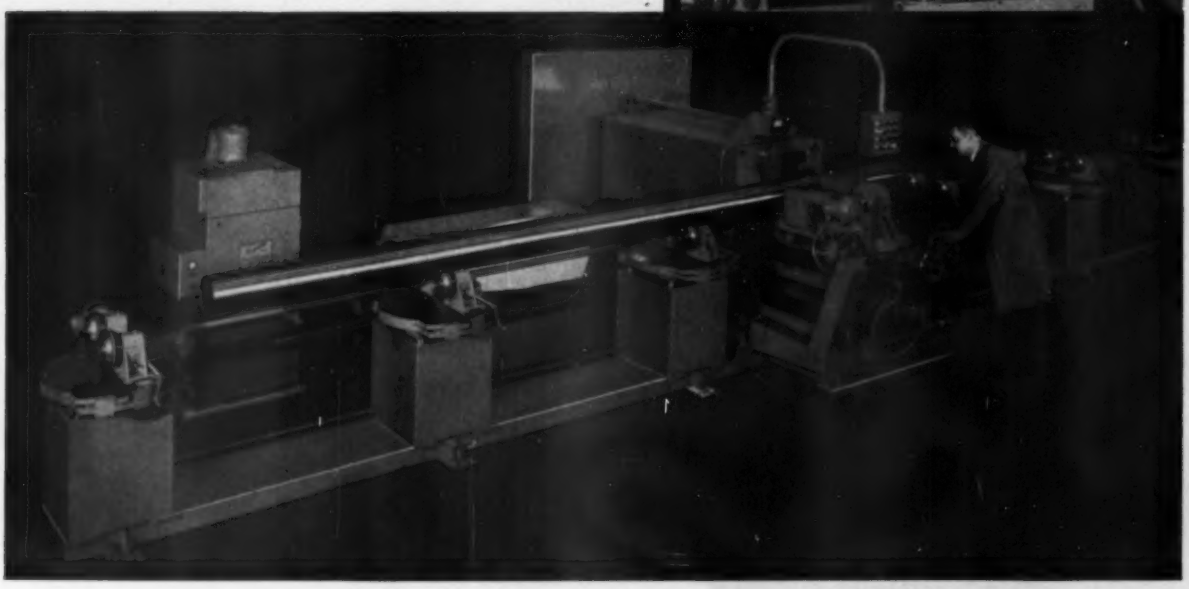
BELT GRINDING: combines rapid stock removal with improved quality on roughing and finishing operations

Take the new Sundstrand-Engelberg Model 8132-HD centerless belt grinder; it can handle stock from3/32″ to 8-1/2″ dia. at through-feed rates from 1′ to 40′ per minute — and produce to high finish and tolerance requirements. Also, because stock through-feeds in either direction, non-productive time on multiple-pass work is eliminated.

One user is removing .020″ stock per pass on 8″ dia. steel tubes at a through-feed rate of 7′ per minute.

For more information, send for literature and ask for a Sundstrand "Engineered Production" analysis of your final finishing operations to determine the economic benefits of abrasive belt grinding on your jobs.





CHECK THESE FEATURES OF ABRASIVE BELT GRINDING:

GREATER PRODUCTION. Because of higher speeds, more grinding area, simpler set-ups, and no time loss for truing or wheel dressing, production is higher. Belts are sharper due to grain orientation. Flexing works out chips for better cutting edge exposure. Change-over time is reduced to a few minutes. Roughing and polishing can be done with only one setup.

• • •

MORE VERSATILITY. Any material can be machined: metallic or nonmetallic. They're efficient for either mass production, small lots, or toolmaking. They're more easily automated than many other machines.

• • •

LOWER COST. Remarkable production lowers costs per piece. You don't need skilled labor for their operation nor elaborate, expensive fixtures. Belt grinders cost less initially than most other finishing machines. Also, belts are less expensive than wheels and are much easier to store and handle.

• • •

SIMPLE AND SAFE. Abrasive belt machining is safer because wheel hazards are eliminated. Operator fatigue is reduced and chips present no problems. Belts are easily changed by inexperienced personnel.

SUNDSTRAND ENGELBERG

SUNDSTRAND-AMERICAN BROACH

ANN ARBOR, MICHIGAN • DIVISION OF SUNDSTRAND CORPORATION

New Norgren Line of Compact Units

for processing compressed air

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HOpkins 7-4884

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Air & Hydraulics Eng., Inc.
ALpine 2-6101

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SPring 7200

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Filter-Regulator Combination Units

Type 73AB
⅛" pipe size.

Manual-Drain Compressed-Air Filter

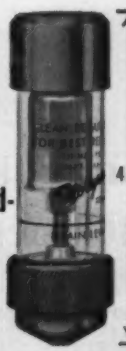
Model 30AJ-1—
⅛" pipe size.

Pressure Regulators

Type 20AR—for air, water, oil and similar fluids—⅛" and ¼" pipe sizes.

Diaphragm-Type Relief Valves

Type 40AB—for air, water, oil and similar fluids—⅛" and ¼" pipe sizes.



Automatic-Drain Compressed-Air Filter

Model 30BJ-1
⅛" pipe size.

Micro-Fog Lubricators

Model 10AG-1L—lubricates air-operated equipment and machine bearings.

Model 10AH-1L—lubricates air-operated equipment.

Both models ⅛" pipe size.

Micro-Fog Lubro-Control Units

The new Norgren compact units may be used singly or in combination. Illustrated is a lubro-control unit made up of a 30AJ-1 filter, 20AR-1GG regulator and 10AH-1L lubricator—⅛" pipe size.

Norgren compact units give you big performance in small space. For complete information on the complete line of Norgren filters, regulators and lubricators in all sizes, call your nearby Norgren Distributor, listed at left—or write for brochure NA-3.

C. A. NORGREN CO. FOUNDED IN 1926

3436 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

You can turn a profit on a New Britain +GF+ Copying Lathe

Here's a birdseye view of a New Britain +GF+ Copying Lathe. It shows some important differences between this machine and conventional lathes with copying attachments. The point here is this—*the most effective use of the single-tool copy-turning principle can be made only with a machine designed from the ground up for this type of work.* The New Britain +GF+ is just such a machine. Notice the chip pan. It's big (it has to be) and located for easy removal of chips from the back of the machine. The design of the work area allows for unobstructed free-fall of chips out of the way and into the pan.

The New Britain +GF+ is massive and rugged, with plenty of power—up to 40 h.p., if you need it. It's simple to operate, quick to set up and change over. The single-point tool can be changed in one minute and it out-produces gang tooling setups in the bargain. Turning is controlled by either a template or a prototype. External and internal copying are accomplished in one set-up with special tooling.

The possibilities for short or long run chucked and between centers work on the +GF+ are wide and varied. Because the work is produced with good surface finish and dimensional accuracy, grinding can be reduced and, in some instances, eliminated. Large diameters are broken down economically by successive parallel cuts, automatically if desired, with optional two-cut or multi-cut recycling.

You've got to see one of these machines in action to fully understand the kind and quantity of work they are capable of producing. Contact your New Britain Representative for demonstration arrangements or write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

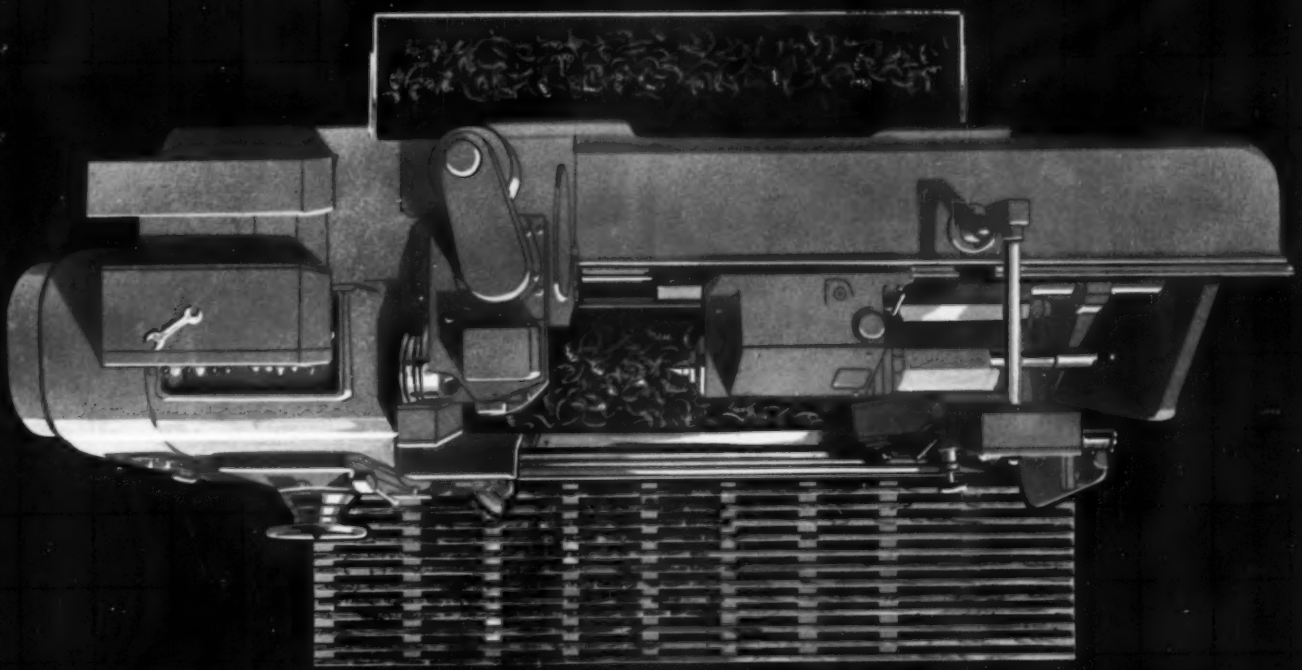
NEW BRITAIN - GRIDLEY MACHINE DIVISION

Unlimited tooling combinations with New Britain Bar Machines

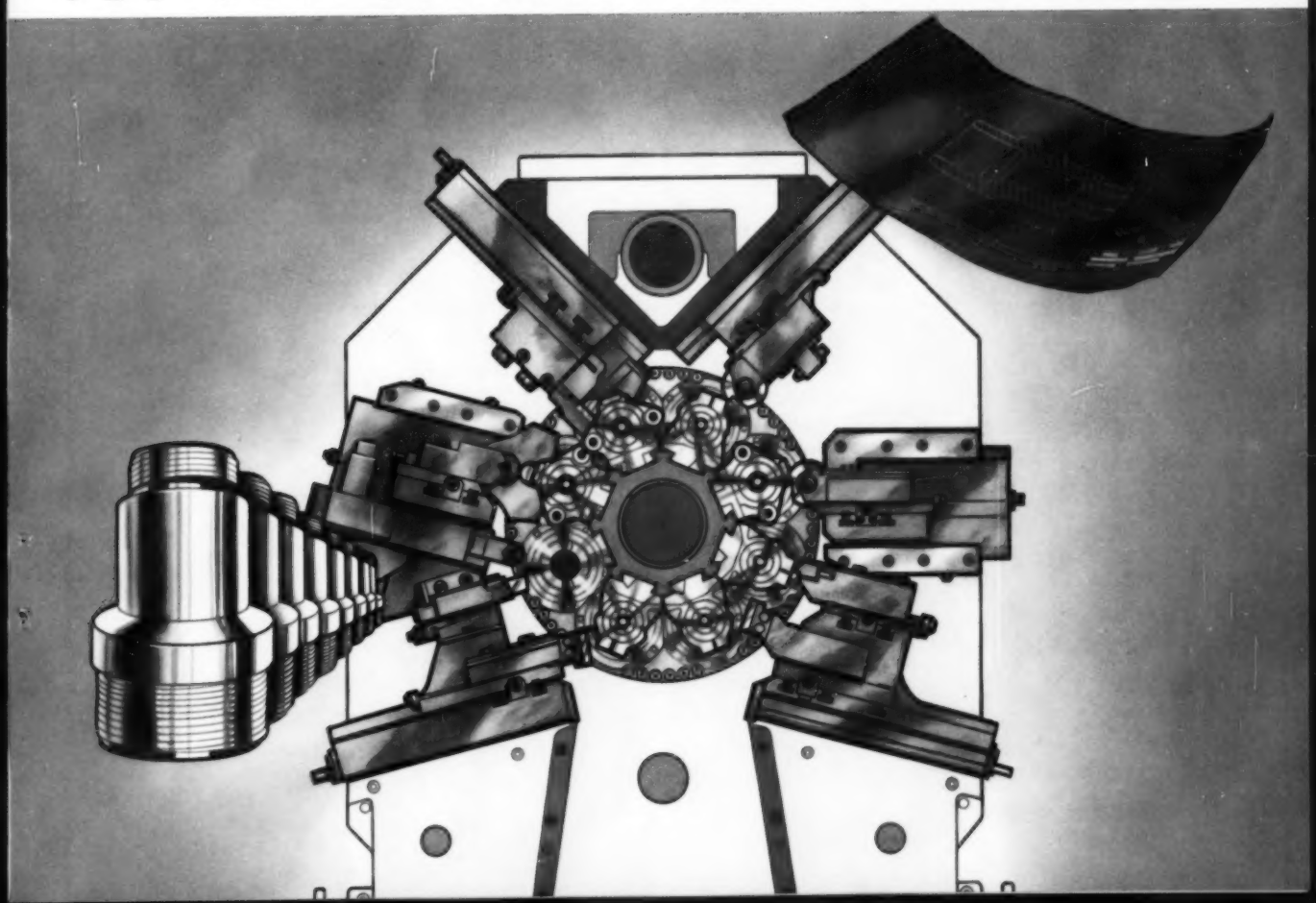
Nothing can out-date your operation quicker than better machines in the hands of a competitor. In the race to keep ahead on quality, price and delivery, nothing can put you out front faster than machines capable of consistently producing the highest quantity of finished pieces at the lowest possible cost. New Britain's new series of bar machines represents in every way the most advanced bar-turning units available. Each of the four-, six- and eight-spindle models has been redesigned, adding new features and improving older ones. Unlimited cross slide and end-working tool combinations, extremely fast operation (even on stainless) and a variety of models and features to choose from add up to some good reasons for incorporating New Britains into your replacement or production expansion plans.

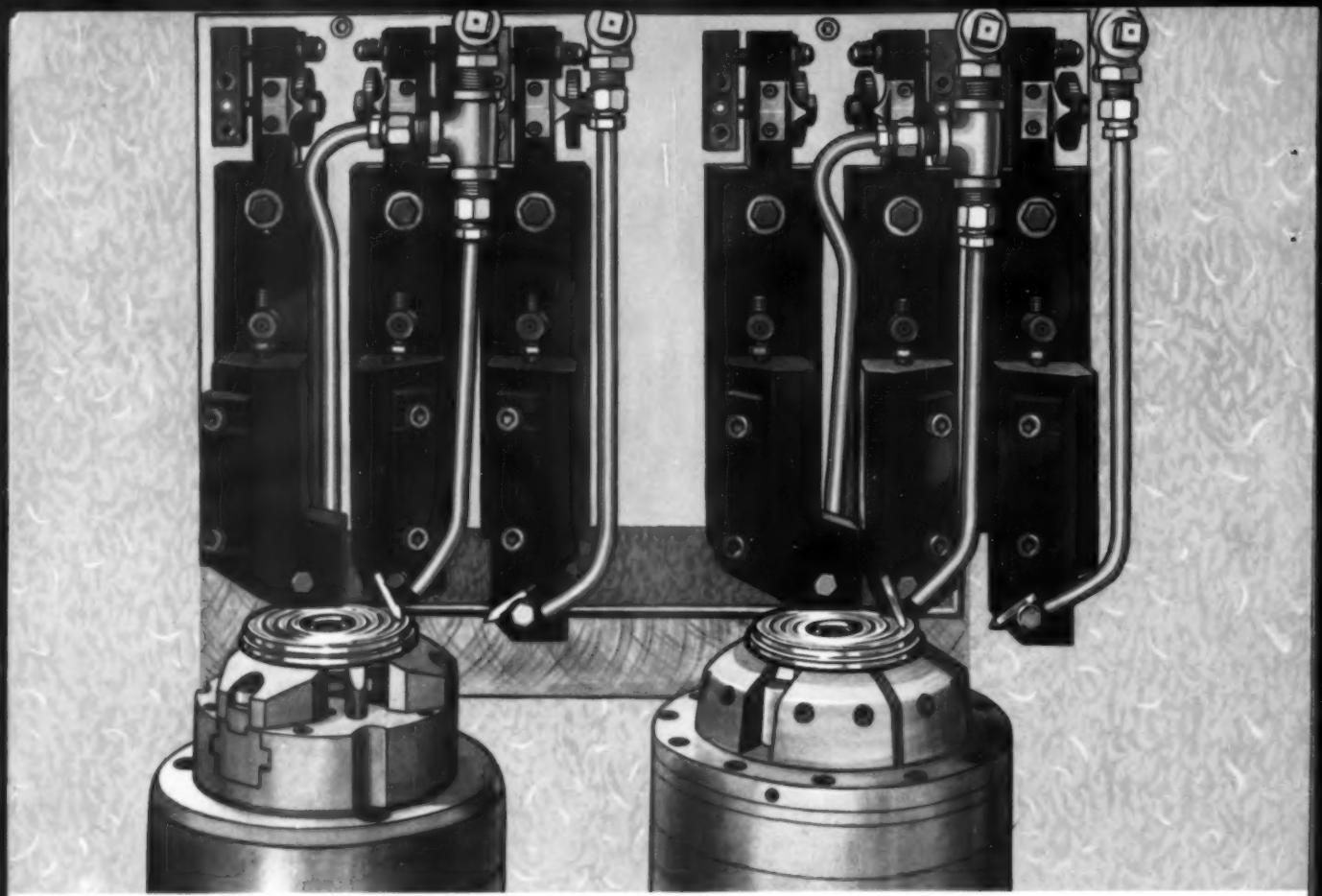
The eight-spindle model is the largest, most modern eight-spindle bar machine available. It has a stock capacity of up to 2⅝" and provides six independently-operated cross slides. As with all New Britain bar machines, the operations of the cross slides and end-working tool slide are disc-cam controlled for positive actuation, close tolerance machining and easy, rapid change-overs.

This is only a very small part of a story that is bound to interest you. The whole story and its significance in terms of your profits is available from your New Britain Representative. If you prefer, contact us directly at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

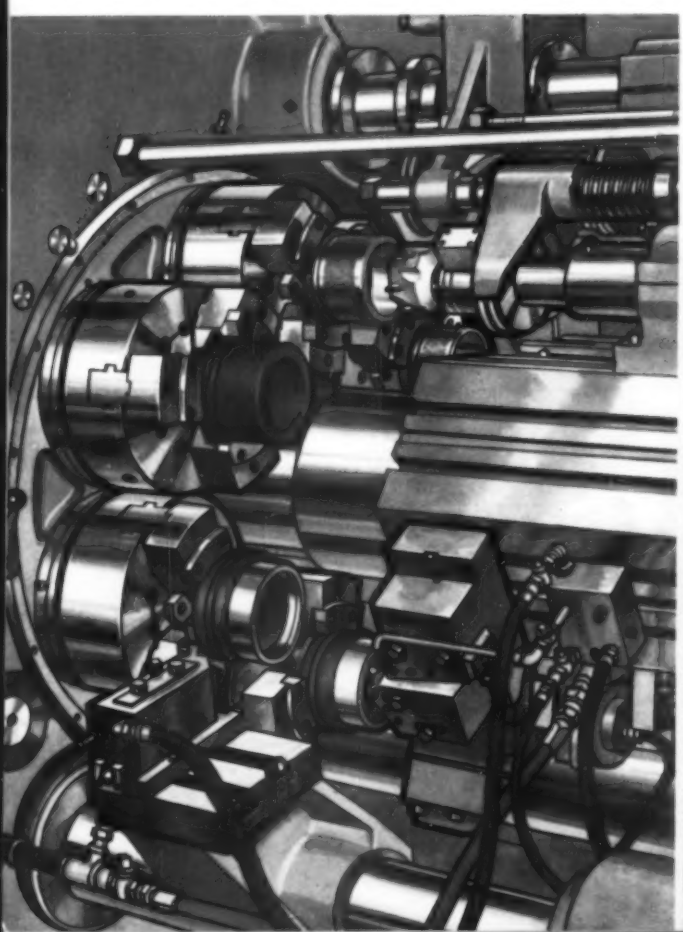


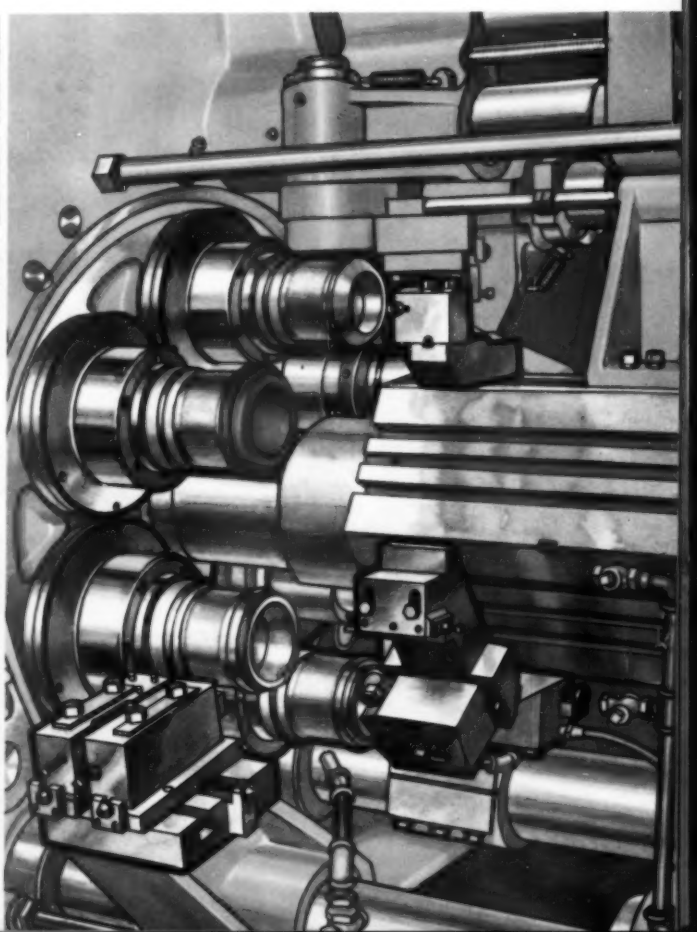
THE NEW BRITAIN MACHINE COMPANY





NEW BRITAIN · GRIDLEY MACHINE DIVISION





New Britain's new concept for contour turning and boring

Beyond a certain point, continued refinement of existing designs in machine tools ceases to make an appreciable contribution to performance. Thus in designing our New Series of Vertical Precision Boring Machines, we have incorporated several completely new design concepts to provide improved performance and greatly increase over-all usefulness.

For the first time machines of this type can be used as building block units. Their clean-sided design permits any number of self-contained machines, each with one or more spindles, to be arranged side by side and operated as a single unit. They also may be operated with equal efficiency as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine.

In order to take the fullest advantage of the precision inherent in cam control, long linkages between cams and slides have been eliminated. A pair of cams is mounted on a common shaft which is carried *within the vertical slide.* Since all slide actuating forces are contained in the vertical slide, both cams are directly adjacent to the slides they control and no outside forces are imposed on the slide ways. The result is maximum rigidity for heavy cuts coupled with extreme accuracy for close tolerance work.

This unique and eminently workable approach to contour turning and boring results in the highest order of accuracy on even the most complex pieces. Your New Britain Representative can give you details on the nine different models available in this series. For catalog material, write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

THE NEW BRITAIN MACHINE COMPANY

New Britain . . . still the best Chucker you can buy

We're not unhappy about the fact that for years, in many plants, the name New Britain has been synonymous with chuckers. New Britain Chuckers have turned out literally millions of pieces of work for practically every major industry in the world. This is less important to the prospective buyer of one of these machines, however, than the capabilities of these machines today. How do they stack up against other chuckers or even other types of machines capable of doing similar work? Pretty well, we think.

New Britain's open-end design still can't be beat for unlimited accessibility to the tooling area. This same wide-open feature makes it doubly more practical to adapt these machines to automatic loading and unloading.

The unusual combination of longitudinal and transverse forming motions is another unbeatable New Britain feature. The massive forming arms on New Britain Chuckers allow heavier cuts and cuts of much greater complexity. This ability to do more work can eliminate the need for second operation machines in many instances. For really complex work, two chuckers set up side by side, as shown here, each doing one side of the piece, can smooth the way for high production. Less complicated work can be set up to perform both sides of the same piece on a single machine.

These massive machines provide the tooling combinations, spindle speeds and power to perform the widest possible variety of work. Their basic design will stay new for years to come, continuing to provide profitable operation. You may know New Britain Chuckers, but you may not be fully aware of the improved series presently being offered. Why not call your New Britain Representative or contact us at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

Millers Falls® drivers boost production 20% at Emenee Industries

Maintenance costs 25% less

Accurate "Adjustomatic"® Clutch

William Kreizel, partner at Emenee Industries, Inc., world's largest manufacturer of musical toys says: "Based on our successful experience with Millers Falls screwdrivers, I am sure we will eventually standardize entirely on these high production tools."

Ninety Millers Falls drivers are now operating on Emenee's fast-moving assembly section. Kreizel and Herbert Brummel, Emenee production and tooling engineer, decided on MF Drivers for these important reasons:

"Exclusive 'Adjustomatic'® clutches give operators accurate and uniform torque control far beyond the capabilities of our old drivers. Smallest screws are never driven too deeply. Cracked cabinet frames and metal joinings are eliminated.

"Versatility of the many quick-change auxiliary attachments and varied suspensions ideally suit our needs.

"Extremely long life and trouble-free operation saves us money and production loss by minimizing down-time.

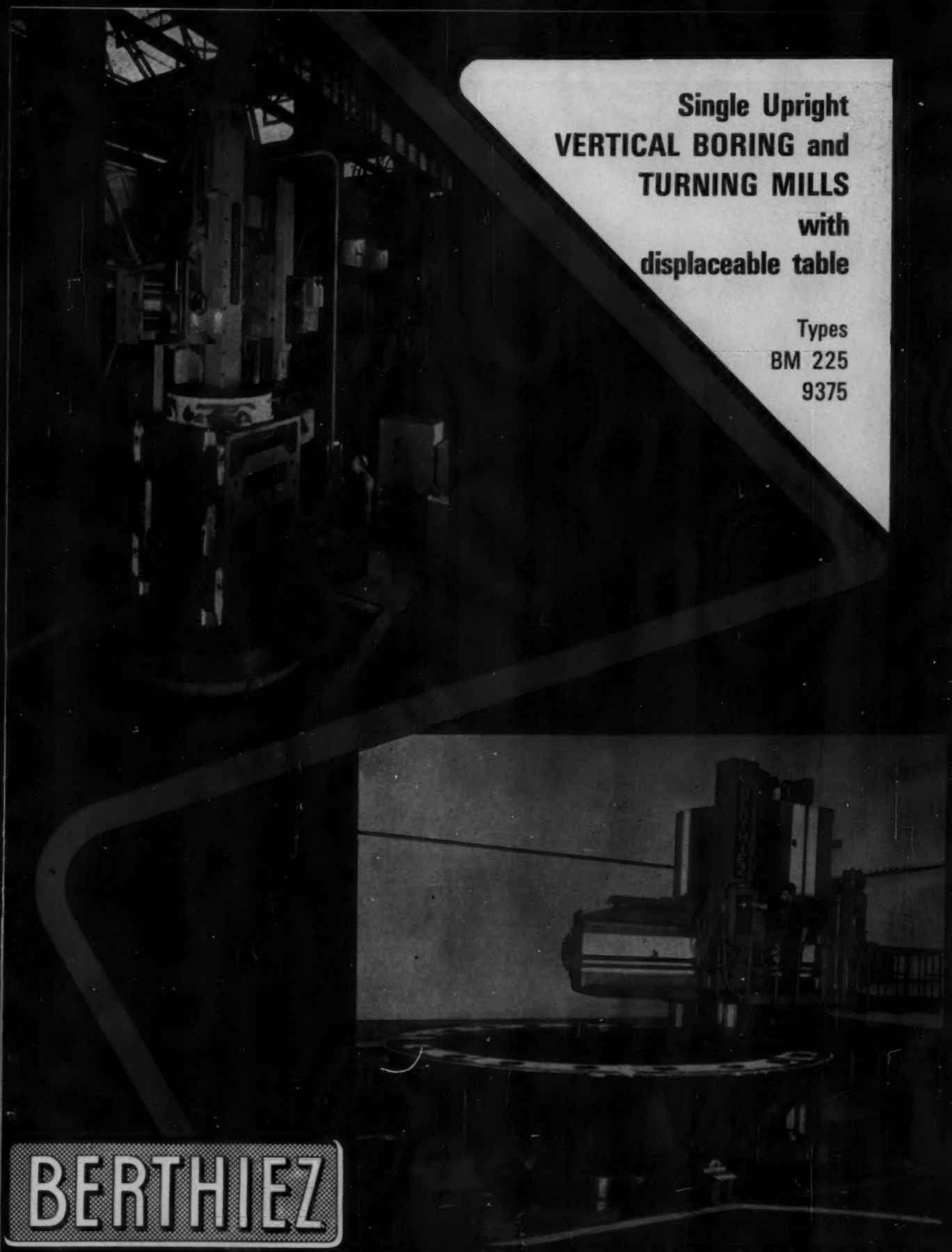
"Simple operation makes it possible to train unskilled workers to do close-tolerance jobs rapidly and efficiently."

As at Emenee, more and more manufacturers are finding Millers Falls electric screwdrivers are the answer to faster, more economical assembly. No job is too small or too tough for MF drivers. Full information on request — or why not let us arrange for a demonstration on your own work?

MILLERS FALLS TOOLS

Write today for full information

MILLERS FALLS CO.
Greenfield, Mass.
Dept. AM-23



Single Upright VERTICAL BORING and TURNING MILLS with displaceable table

Types
BM 225
9375

BERTHIEZ

Société Anonyme des Anciens Etablissements Charles BERTHIEZ - Givors - Rhône

They Put "Automation" In The Dictionary

Much U. S. production was already automatic by 1948. But the idea of *automation* was not only new—there wasn't even a word for it.

Then came the October 21st issue of AMERICAN MACHINIST/METALWORKING MANUFACTURING with its story: "Ford Handles By Automation". A word was born...coined by Ford's Del Harder . . . and with it, a new concept of production.

What kind of magazine . . . and what sort of editor . . . could have this influence?

In his 22 years as editor, Burnham Finney has made AM/MM the first place the metalworking industry looks for news of trends and developments. His own series of three articles on automation in 1955 won the first Jesse H. Neal award for outstanding editorial achievement in business publications. Other features under his direction won Neal awards again in 1957 and 1959.

Finney himself is a rare sort of editor—except at McGraw-Hill. He doesn't wait for news to come to him. He goes to it . . . seven trips to Europe in the last nine years to report on the latest developments there, and endless prowling through domestic plants. In an average year, he will log some 30,000 miles of travel, plus as many as 2,000 personal contacts with metalworking executives.

Backing up Burnham Finney on AMERICAN MACHINIST/METALWORKING MANUFACTURING are 16 other skilled editors. Like Finney himself—like all McGraw-Hill editors—they are seasoned experts in the fields they cover. Their objective: to give readers the information they need to help do their jobs better.

This is one big reason why over 1,000,000 key businessmen pay to read McGraw-Hill publications. And because they're vitally interested in what goes on in their fields, these men are a receptive audience for your advertising.

McGraw-Hill

PUBLICATIONS

McGRAW-HILL PUBLISHING COMPANY, INC.,
330 WEST 42nd STREET, NEW YORK 36, N. Y.

Here, at an automation operation, an intake manifold is milled and drilled on a production line operated from the console panel at the left in Ford Motor Company's engine plant at Dearborn, Mich. The men, left to right, have all played a large part in automation: John Dykstra, Vice President, Manufacturing, at Ford; D. S. Harder, a retired Executive Vice President; and Burnham Finney, Editor of AMERICAN MACHINIST/METALWORKING MANUFACTURING.

MORE THAN 5,000,000 TONS OF STEEL WITHOUT A BEARING FAILURE

The Torrington Company, Bantam Bearings Division, South Bend, Indiana, is especially noted for the high quality of its rolling mill bearings. Usage of modified AISI 3310 USS CARILLOY Steel in races enables Torrington to manufacture quality bearings with a foot-pound energy absorption rate of a magnitude impossible to obtain with any other conventional alloy steel. Translated into performance, rolling mills equipped with these bearings have produced more than 5,000,000 tons of steel without a bearing failure!

Before using the modified USS Alloy grade, Torrington tried several different types of steel which gave considerably lower tonnages before failure occurred. Then with the application of the 4% nickel alloy (Modified 3310) they first succeeded in obtaining progressively higher tonnages to the 5,000,000-plus tons of rolled steel production enjoyed today.

In addition, the Torrington Company uses the 52100 series of USS CARILLOY Steels. The types of 52100 steels used in through-hardening anti-friction bearings consist of grades similar to AISI 50100, 51100, and 52100. These steels have certain special characteristics such as wear resistance and compressive properties essential in bearings, which are obtained by adding varying amounts of chromium to high carbon steels.

The chromium, manganese, silicon are varied according to the cross section involved in the finished part and its expected response to heat treatment, or the microstructure needed to impart wear and other special properties. USS CARILLOY Steels in this class have long been noted for their superior quality, cleanliness and wear resistance.

Special alloy steels such as those used by Torrington can be developed for other special needs. In addition, all standard alloy steel grades in a complete range of USS bar and semi-finished sizes are available. For more information, write United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

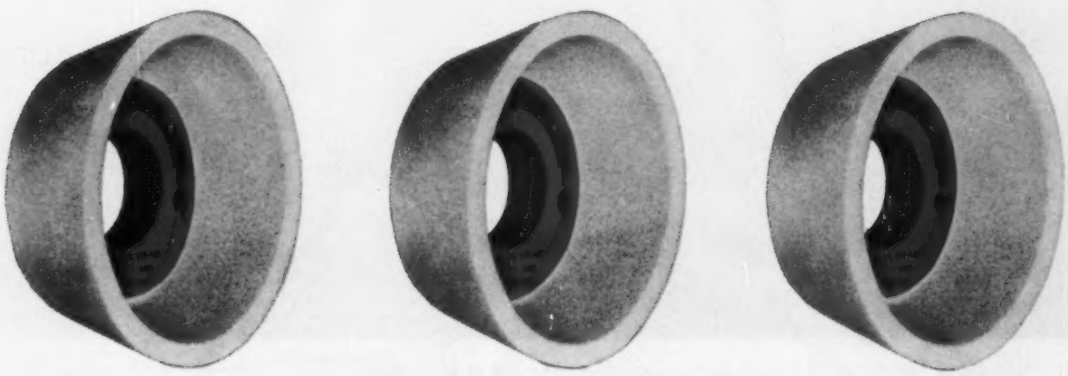
USS and CARILLOY are registered trademarks

This mark tells you a product is made of modern, dependable Steel.

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Ala.
United States Steel Supply—Steel Service Centers
United States Steel Export Company
United States Steel

Inspector checking a Torrington 4-row tapered roller bearing used in metal rolling mills. A special 4% nickel alloy was used for greater wearing qualities.

POSITIVE DUPLICATION – EVERY TIME!



You can depend on a rubber stamp to print identical information time after time after time. You can also depend on the Positive Duplication of these toolroom cup (PD)* wheels—and all CINCINNATI (PD) GRINDING WHEELS.

HERE'S HOW (PD) IS ACHIEVED

To supply you with wheels of uniform excellence, Cincinnati's unique (PD) manufacturing process is unvaryingly regulated by 36 separate quality controls. For example . . . Humidity and temperature of the Wheel Mold Room are kept at the same levels every day throughout the year—an essential safeguard of (PD) uniformity.

RESULT: DEPENDABLE PERFORMANCE

Each (PD) reorder wheel gives you exactly the same good job as the original. Production goes up and stays up. Costs go down and stay down. This is the promise and performance—of Positive Duplication.

CALL CINCINNATI TODAY

Solve your grinding problems with the help of Cincinnati's factory-trained specialists. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI (PD) GRINDING WHEEL Distributor, or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

(PD) POSITIVE DUPLICATION

CINCINNATI®

GRINDING WHEELS

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

INNOCENTI mechanical division

Continuous Mill in operation at
DALMINE S.p.A. works in Costa Volpino, Italy

continuous mill

for the manufacture of seamless steel tubes and pipes

The Continuous Mill associated with the Stretch Reducing Mill in the double version for making tubes from $^3/_8$" to 4" and from $2^3/_8$" to 7" successfully meets present requirements for consistently higher quality and quantity.

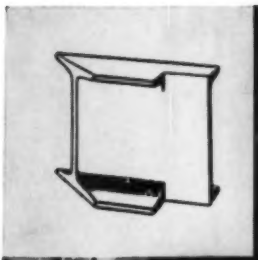
- Highest Capacity: the annual production can reach respectively 150,000 and 250,000 tons in the two versions.
- Highest yield: 93% - from billet to tube
- Complete automation: 1,5 man hour per produced ton
- Possibility to make tubes with 2,25 mm minimum thickness without stretching
- Extremely easy to operate
- Low installation costs in respect of capacity.

These features make the Continuous Mill the most reliable tube making equipment for new installations or the modernization of the existing ones.

INNOCENTI

MILANO Via Pitteri 81 - tel. 23.93 • **ROMA** Via Parigi 11 - tel. 487.051 • **NEW YORK** 43 West 61 Street - N. Y. 23 - tel. Columbus 5-7795 • **PARIS** 6, Av. F. Roosevelt - VIII - tel. Balzac 03-51 • **LONDON** U.K. Representative-Uganda House - 58/59 Trafalgar Square, W.C. 2 - tel. Whitehall 2075 • **CARACAS** Edif. Sudameris Avenida Urdaneta y Fuerzas Armadas - tel. 545.461

CIRCLE 286 READER SERVICE CARD



COPING AND MITERING HEAVY STRUCTURAL SHAPE

18" Beam (above) is held between vises for the short cut. On the long cut (left) vises were removed and beam held by simple clamp. The MARVEL Band Saw is truly indispensable in ornamental and structural iron shops where this type of work is done daily. The machine will cut-off square, miter and cope any work shape from the smallest moulding to 18" I-beams.

SPLITTING CLAMP RINGS, BUSHINGS

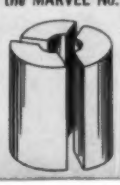
Splitting clamp rings, connecting rods, bushings and collets is a fast, simple operation on the No. 8 Band Saw. Perfect control, quick chucking facilities, accuracy and speed are features that especially fit the machine to handle this type of work.

MITERING LARGE DIAMETER PIPE

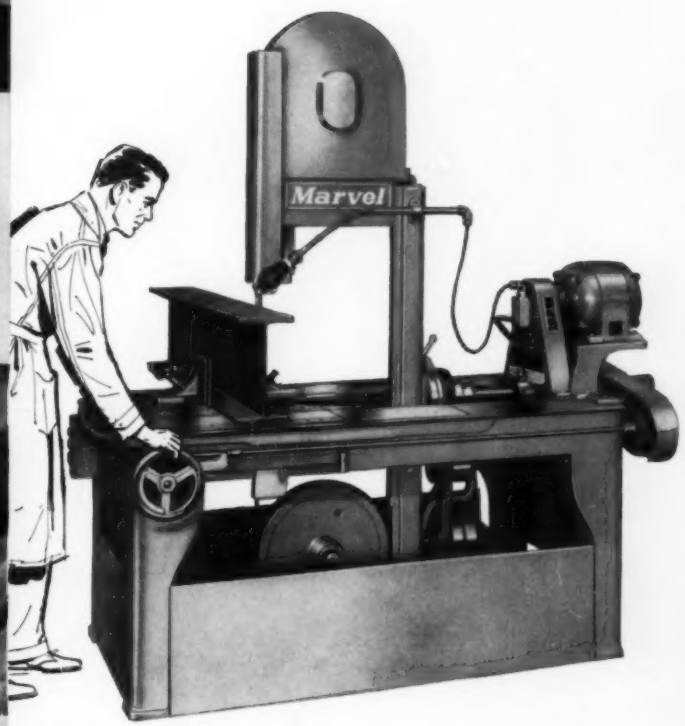
Pipe (or any bar shape) may be mitered at a 45° angle without the need for special jigs or fixtures. Even when cutting miters, work remains in the same position as it does for straight cuts. Column and blade are instantly tilted to desired angle, even without stopping the machine. Perfect miters (or lesser angles) are sawed without any layout or special equipment.

SEGMENTING LARGE DIE BLOCK

Three equally spaced re-entrant cuts were made in this 16" x 18" SAE 4130 Forging. Job was completed, floor-to-floor in 5 hours. No special jigs or fixtures were required. An unusual job that serves to emphasize the versatility of the MARVEL No. 8 Saw.



"The One Machine We Couldn't Do Without"



"As simple to use and handy as a Scout Knife" is the way another user described his MARVEL No. 8 Universal Band Saw recently . . . and we can't think of a better way to describe this versatile metal cutting machine.

With a MARVEL No. 8 Band Saw, you can do almost any conceivable straight, angle, or miter metal sawing job—from cutting-off bar stock to making the most unusual forming cuts. You can handle small, delicate work, and in the next minute, saw structurals, or segment large work as illustrated in the lower photograph. You will save time, labor, and material with a MARVEL No. 8 Band Saw because no other saw has all the features to be had in this truly universal tool.

Upright column design and forward travel of the blade through the work (which remains stationary on the table-height saw bed) provides easy, unobstructed visibility and more convenient and efficient working conditions; column can be tilted and locked at any angle up to 45° left and right of vertical; the exclusive MARVEL Power Feed with Automatic Overload Relief; Automatic cutting-depth stops; simple, convenient operating controls—these are some of the features which make the No. 8 Band Saw the most useful—and used—metal cutting saw on the market.

For the complete story, ask or write for Bulletin 875 which illustrates and describes MARVEL Universal Metal Cutting Band Saws.

MARVEL *Metal Cutting* SAWS

Better Machines-Better Blades

ARMSTRONG-BLUM MFG. CO. 5700 W. BLOOMINGDALE AVE. • CHICAGO 39, ILL.

CIRCLE 287 READER SERVICE CARD ▲

CIRCLE 288 READER SERVICE CARD ►

Gulfcut® 45A oil cuts machining time almost in half, permits

GULF MAKES THINGS

Trouble! The Millar and Frey Screw Machine Products Company, Union, New Jersey, found plenty when it recently contracted to produce a small machined steel part. Specifications called for drilling a deep, blind hole — perfectly flat at the bottom. They also required a hole sidewall that forms perfect right angles to the bottom. Close sidewall tolerances. And a fine finish—with no burrs left in the hole. To handle these machining requirements, Millar and Frey tried six different cutting oils. All failed.

And then, the company tried Gulfcut 45A—a highly compounded sulfo-chlorinated-lard oil. The results: Not only were the requirements met, but Gulfcut 45A enabled Millar and Frey to increase speeds and feeds 48 percent, and slash machining time from 34 to 18 seconds.

In addition, Millar and Frey stepped up the production of a small tellurium copper component with Gulfcut 45A. Edmund Frey, one of three partners, says, "Now, we're machining tellurium copper at brass speeds. Our tools

Round up. Typical parts machined by Miller and Frey Screw Machine Products Company. Gulfcut 45A is used on 75 percent of all machining jobs.

Left to right, Edmund Frey, J. H. Schindler, Gulf Sales Engineer, and Robert Millar. Both partners agree that Gulfcut 45A gives top performance.

Tellurium copper component. It's being machined at brass speeds, thanks to Gulfcut 45A.

48% increase in feeds and speeds . . .

RUN BETTER!

last longer. Gulfcut 45A doesn't stain or discolor the working piece either."

Today, Millar and Frey use Gulfcut 45A on 75 percent of their machining jobs. Ed Frey tells why: "This oil is the most efficient, all-round cutting oil I've ever used."

If you've got a machining problem, try the Gulfcut line. See for yourself why Gulf makes things run better! Just call a Gulf Sales Engineer at your nearest Gulf office. Or, write for illustrated literature.

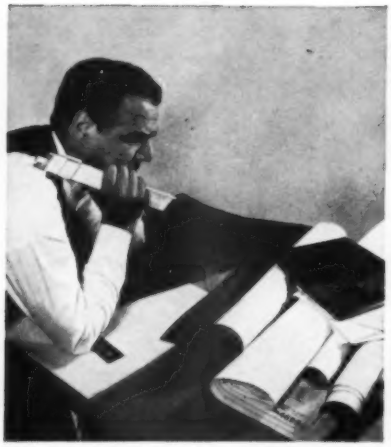
GULF OIL CORPORATION
Dept. DM, Gulf Building
Houston 2, Texas

GULF

5P-9886

NEW TOOL STEEL SERVICE

helps you estimate costs more accurately!

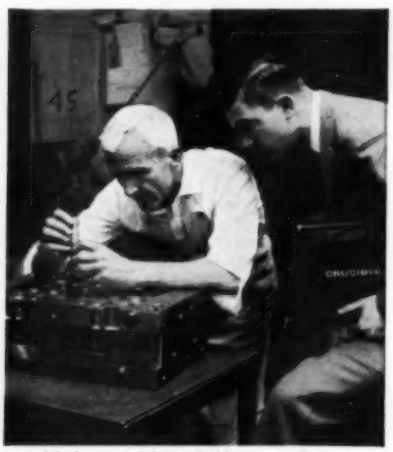


Estimating tooling costs, especially on new jobs,

becomes more accurate and profitable with Crucible's new Tool Steel Service.

This service enables you to use fewer grades of tool steels...

which you get to know inside-out! So, you can more accurately predict



machining and bench time, and response to heat treating.

And because you're completely familiar with all the basic grades you use...

you can pin-point your estimates and your actual costs.

For the complete story on all the cost reductions available with this service, call in a CRUCIBLE Service Engineer.

CRUCIBLE STEEL COMPANY OF AMERICA

Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, N. J. • Charlotte • Chicago • Cincinnati • Cleveland • Columbus • Dallas • Dayton Denver • Detroit • Erie, Pa. • Grand Rapids • Houston • Indianapolis • Los Angeles • Miami • Milwaukee • Minneapolis • New Haven • New York • Philadelphia Pittsburgh • Portland, Ore. • Providence • Rockford • Salt Lake City • San Francisco • Seattle • Springfield, Mass. • St. Louis • E. Syracuse • Tampa • Toledo • Tulsa
CRUCIBLE STEEL OF CANADA, LTD., SOREL, QUEBEC, CANADA

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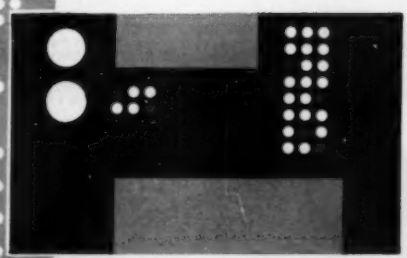
▲ CIRCLE 290 READER SERVICE CARD

Advertisement

IMPORTANT NEWS for manufacturing

NUMERICAL CONTROL



in metalworking

a data file
of equipment, systems
and controls

what numerical control offers metalworking

1. Fully automatic performance of all machining operations within the capability of the basic machine tool; any degree of automaticity.

2. Rapid interchangeability of control data from one job to another by simply inserting a new set of instructions.

3. Reduction in number of work setups and considerably less setup time.

4. Mathematical accuracy in the preparation of control instructions.

5. Drastic reduction in tooling, such as jigs and fixtures, which conventionally provide positioning and sequencing actions that are inherent in numerically controlled machines. No waiting for tool preparation.

6. Major savings in inventory because lot sizes can be determined by short-term need rather than by absorbing tooling and set-up costs.

7. Virtual elimination of scrap because human control over machining procedures is minimized. Parts duplication is constant and accurate.

8. Increased machine tool utilization.

9. Instructions that do not deteriorate with use, that can be readily modified, conveniently stored, shipped or mailed anywhere with speed and economy. It is even possible to transmit them between plants via teletype. A single file drawer can contain the equivalent in tape or cards of a large tool-storage warehouse.

10. Process preparation, if desirable, that can be remote from the manufacturing area.

11. Production pace set by machine, not by operator. Numerically controlled machines show productivity average three times that of manually controlled machine tools.

12. New business opportunities to be found in previously unprofitable work.

This special advertising section of data on numerically controlled equipment, systems and controls is placed on perforated pages to permit removal from the magazine and filing for future reference.

Keys to selecting numerical control

What is numerical control?

Numerical control is a fundamental concept of process control. For the first time in the history of manufacturing, this concept permits putting the actual physical values or quantities – such as dimensions or speed – into the process equipment as simple numerical symbols which can be interpreted through punched tape, magnetic tape, punched cards or simple dials or push buttons. Control "by the numbers" is applicable to any process, metalworking or otherwise.

Why was numerical control conceived?

It was conceived to create true three-dimensional mathematical shapes in metal. These shapes, vital to modern aerospace technology, were either impractical or impossible to achieve by the best manual methods available. Even the simplest curves in cams and templates can only be approximated by tedious hand finishing. This isn't good enough.

How does this concept aid conventional operations?

Numerical control provides a basic counting or measuring system. For contouring in two or three dimensions, the required machine motions are coordinated to provide a path. To position work on a jig borer, drill press, boring mill, riveter, etc., individual motions can be controlled by simpler point locating systems. The inherent advantages of numerical input improve processing.

What is numerical control's outstanding characteristic?

Because numerical control provides automatic, precise control of all number values inherent in the machine tool, it minimizes tooling and set-up. By lowering the break-even point on the cost of a piece, it makes very short runs practical. Lots of only one or two pieces are efficiently worked. Shop loading can be geared to immediate requirements.

Is numerical programming difficult?

Programming complexity is proportional to the number of motions requiring coordinated control. Programming a positioning system is simple; it can be learned by a capable manufacturing engineer or a set-up man in a few days, or even hours. Programming continuous-path equipment requires some special skills and is usually done most efficiently with the help of a computer.

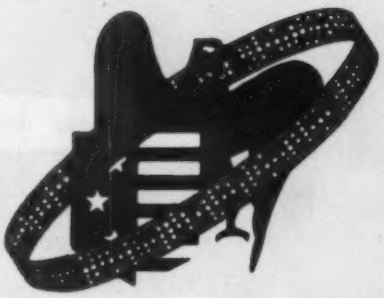
How soon will numerical control equipment pay off?

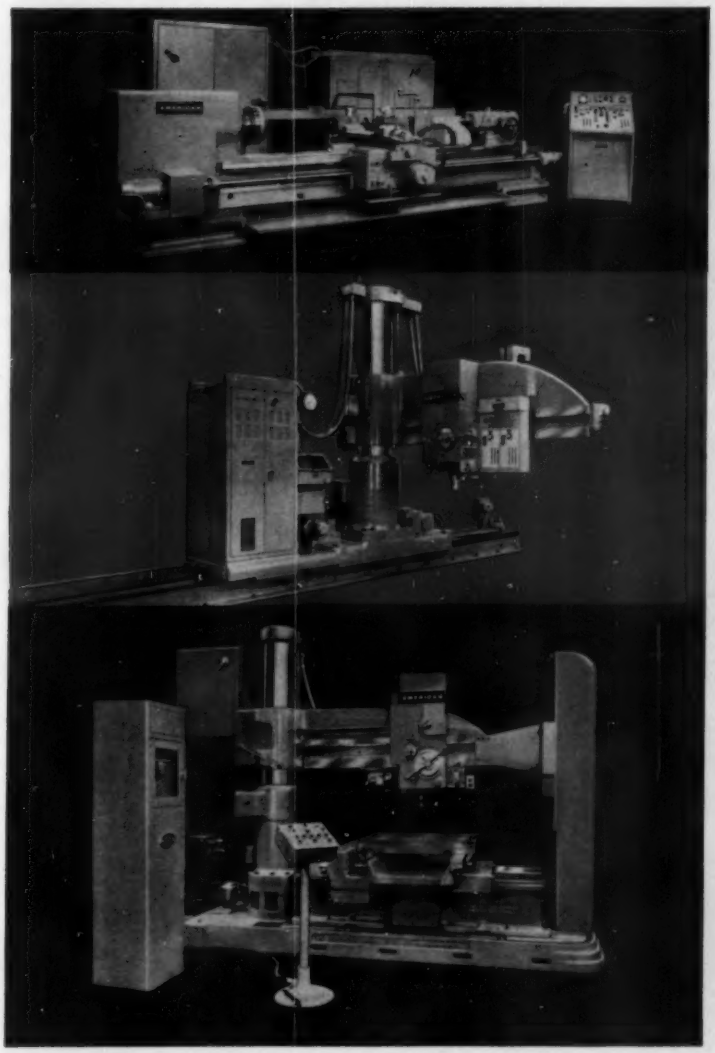
Users of numerical positioning controls are getting two to three times the productivity of conventional machine tools. Typical tooling savings run from 60 to 90%. Set-up time is halved, at least. While most users say they are satisfied to write off their numerically controlled machine tools in three years, operating on two shifts, full utilization can recover the investment in under two years.

AMERICAN TEAMS MACHINE TOOL KNOW-HOW WITH NUMERICAL CONTROL AND GIVES YOU ULTRA-PRECISION ACCURACY, SPEED AND FLEXIBILITY.

Americans all-new tape controlled machine tools are not mere adaptations. Each is designed from the ground up for todays space-age controls . . . and tomorrows!

Before you invest in numerically controlled equipment, find out about the *basic machine tool.*
Find out about AMERICAN!





AMERICAN 2509 TAPE CONTROLLED LATHE

A combination of muscle and brains! This production athlete has fully ground gears, superior spindle mounting, 4-vee-way bed with hardened tool steel outer ways . . . and a deeper, stronger carriage to help give it super rigidity. Tape eliminates operator control . . . gives you engineer-controlled accuracy.

AMERICAN OPENSIDE BORING AND DRILLING MACHINE—TAPE CONTROLLED

For large drilling and boring jobs . . . or a series of smaller ones. Its nitrided Nitralloy spindle and nitrided sleeve matched to .0002" sliding fit and its double lo-hung spindle drive give super accuracy. Rugged! Dependable! Gears hardened and ground . . . built to transmit tremendous power. Does the work of a giant . . . tape control keeps it docile as a baby.

AMERICAN NUMERICALLY CONTROLLED PRECISION BORING AND DRILLING MACHINE

As with all American drills, this one has a precision boring mill type spindle. Its ultra-precision positioning table handles ounces or tons with equal ease . . . positions accurately on either axis to ±.000250" and repeats to ±.000050"! It moves straight and square to ±.000100"! No steel fingers wear or tear the 1", 8 channel mylar tape . . . it's read by low pressure air. And it's punched manually or mechanically, easily and at low cost. Tests show this precise marvel can increase your production up to 400%! Cut tooling costs 71%! Eliminates jigs!

COMPETE COMPETENTLY WITH

AMERICAN

LATHES • RADIAL DRILLS
SPECIAL MACHINES

The American Tool Works Company
Pearl Street at Eggleston Avenue • Cincinnati 2, Ohio

LOOK AT THESE OUTSTANDING PERFORMANCES!

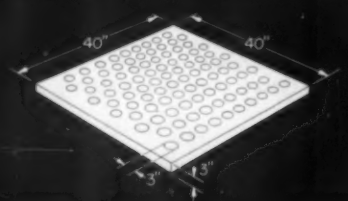
STEEL SHAFT

- Removed 1,078 cu. in. SAE 1045 steel.
- Held 13 diameters to ± .001".
- Total machining time, 34 min.

2509 TAPE CONTROLLED LATHE

SPECIFICATIONS

Swing over carriage wings	25"
Swing over 90° tracer slide	9"
Main drive motor, constant hp 4-to-1 variable speed	50 hp
Spindle speeds	
Number with variable speed motor	20 (tape selected)
Range	50 to 900 rpm
Diameter of longitudinal anti-backlash ball screw	2½"
Pitch of longitudinal anti-backlash ball screw	¼"
Diameter of cross feed anti-backlash ball screw	1½"
Pitch of cross feed anti-backlash ball screw	¼"
Feeds	
Number	20 (tape selected)
Range (in. per min.)	5 to 16 (tape selected)
Automatic indexing square tool turret	Tape selected position
Numerical control	General Electric punched tape



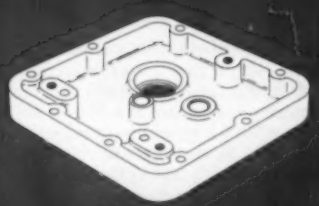
STEEL HEAT EXCHANGER BAFFLE PLATE

- Drilled 96—3" holes through 3" free-machining steel.
- Removed 3,180 cu. in. of metal.
- Total machining time, 82 min.

OPENSIDE BORING AND DRILLING MACHINE TAPE CONTROLLED

SPECIFICATIONS

Column diameter	19"
Travel of boring mill type spindle	18"
Spindle speed and feed shifts	Pre-selective hydraulic
Range of 32 spindle speeds	20 to 1600 rpm
Range of 16 feeds	.003" to .125"
Traverse of drill head on arm (Y-axis)	56" (6' arm) to 104" (10' arm)
Traverse of Saddle on bed (X-axis)	Governed by bed length
Positioning speed, each axis	100" per min.
Main drive motor	30 hp max.
Numerical control	General Electric punched tape
Zero shift	Full shift



CAST IRON GEAR BOX COVER

- Machined complete (drilling, tapping, counter-boring).
- Held ± .00025" hole - to - hole spacing.
- Total machining time, 21 min.

NUMERICALLY CONTROLLED BORING AND DRILLING MACHINE

SPECIFICATIONS

Column diameter	11"
Traverse of arm on column	28"
Spindle	
Type	Precision boring mill
Cycle	Automatic
Traverse	12"
Feed range	.001 to .025 ipr
Range of 12 spindle speeds	45 to 2250 rpm
Main drive motor	7½ hp (max.)
Table	
Size	40" x 32"
Travel	30" x 30"
Numerical control	Sperry punched tape

The American Tool Works Company

Pearl Street at Eggleston Avenue • Cincinnati 2, Ohio

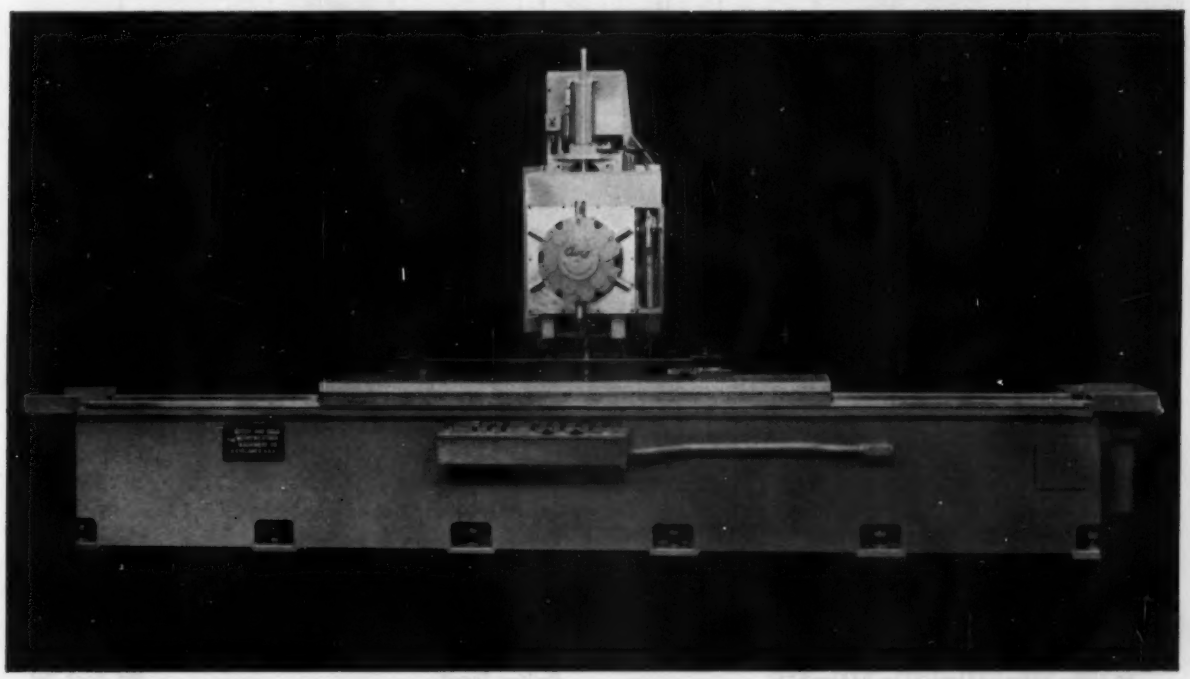
6 precision spindles by Avey

The reliability of the Avey 250 Turret-Dex matches the quality of the thousands of Avey drilling, tapping, and production machines which preceded it. It is available as either an automatic machine or numerically-controlled with rotary or two-axis positioning table. Pre-selected speeds, feeds, rapid advance, and tapping cycles. Automatic depth control for all spindles.

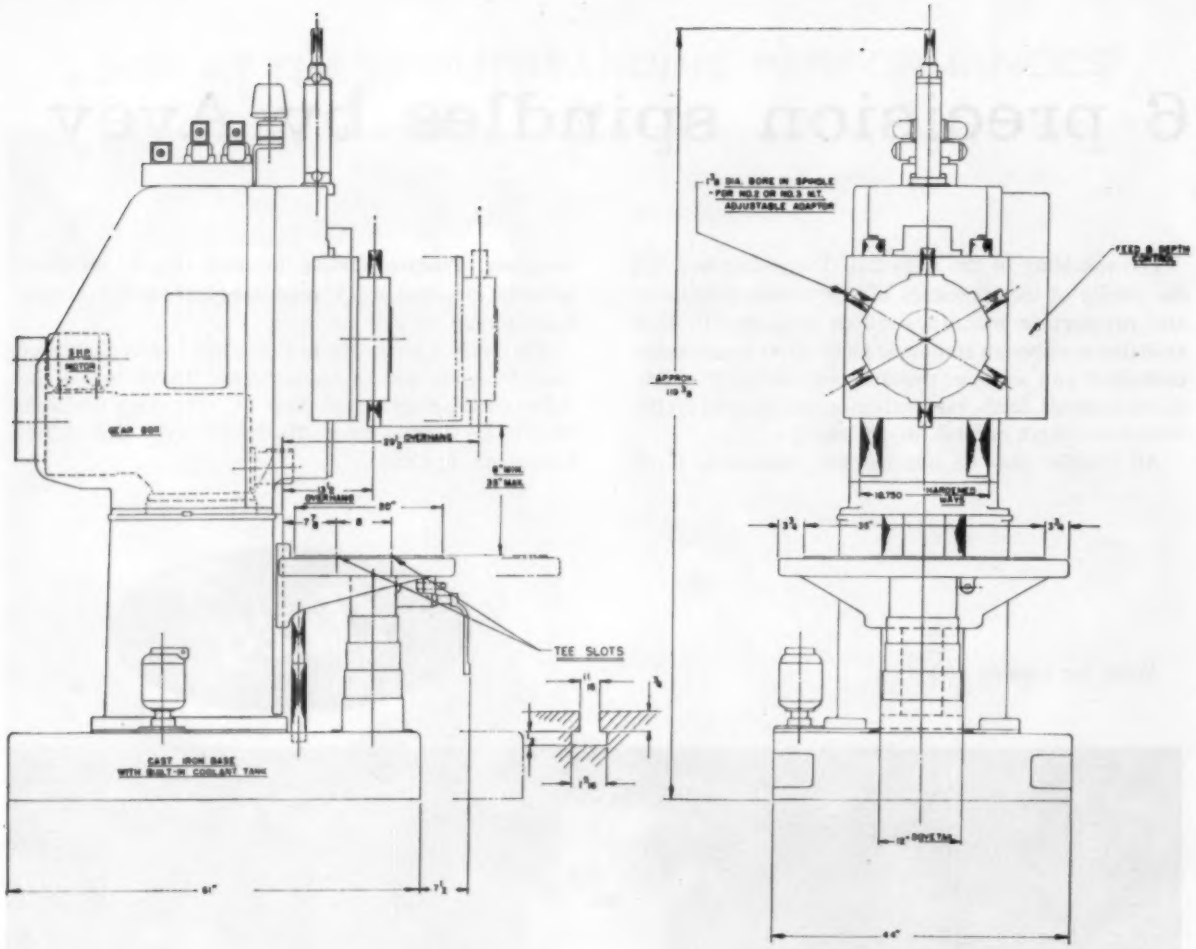
All spindles may be skip indexed. Automatic turret clamping. Positive spindle location. Rigid one-piece spindles, mounted in "O" precision taper roller bearings. Capacity up to 1¼" in steel.

The Avey Turret-Dex makes it more clear than ever that, for your drilling requirements, "Avey makes the right one for Avey makes them all." The Avey Division, Motch & Merryweather Machinery Co., Box 1264, Cincinnati 1, Ohio.

Write for catalog 460



■ *Production costs drop significantly with this combination of an Avey Turret-Dex and a 12"x99" table. The operator can load many workpieces while the six spindles complete operations quickly and accurately.*



SPECIFICATIONS — Avey Turret-Dex Model No. 250

Number of Spindles	6
Capacity—Drill in Mild Steel	1¼"
Tap in Mild Steel	1¼"
Pipe Tap in Mild Steel	1"
Drill Motor (Nema Frame)	5 HP
Drill Motor Speed (Constant Horsepower) 1200 or 900/1200	
Power Feed	Hydraulic
Motor-Hydraulic Power Source for Ram	2 HP
Turret-Dex Way Travel	8"
Number of Spindle Speeds	6 or 12

Range of Spindle Speeds:

Six Speed Machine with Single Speed Motor
(*Select one Range only*)

95—190— 380— 570— 760—1130
or 110—220— 440— 660— 880—1325
or 150—300— 600— 900—1200—1800
or 250—500—1000—1500—2000—3000

Twelve Speed Machine with Two-Speed Constant Horsepower Motor
(*Select one Range only*)

70—145— 285— 430— 570— 850
95—190— 380— 570— 760—1130
or 110—220— 440— 660— 880—1325
150—300— 600— 900—1200—1800
or 187—375— 750—1125—1500—2250
250—500—1000—1500—2000—3000

Rapid Traverse Rate	240 IPM
Penetration Rate	0-120 IPM
Maximum Clearance Spindle to Table	35"*
Minimum Clearance Spindle to Table	8"
Throat Depth	13½" and 29½"
Width of Hardened Ways	18.750"
Spindle Nose	Straight Bore for Nos. 2 or 3 Adjustable Adaptors
Spindle Bearings—Roller Bearings	Class "O"
Maximum Spindle Run-Out	.0005
Positive Adjustable Depth Stops	Std.-Each Spl.
Depth Control Accuracy	.001
Rapid Traverse—Adjustable	Std.-Each Spl.
Positive Dwell	Std.-Each Spl.
Hydraulic Cylinder Bore	3½"
Maximum Pressure at Drill Point	5500 Lbs.
Approximate Shipping Weight (without numerical control and auxiliary table)	12000 Lbs.
Required Voltage	220 V—3 Phase
	440 V—3 Phase
	550 V—3 Phase

*Dimension can be increased on application

N/C Is Moving Ahead. Are You?

Numerical Control is of extreme interest to metalworking management everywhere. It has become the Number One topic of conversation. What can N/C do for you? Consider these advantages: it can reduce tooling costs 50 to 80 per cent; slash lead time; and reduce inventory and the number of production units in process. And Numerical Control gives you a consistently higher quality product.

Now for the first time a complete tape preparation center is available to all manufacturers. Here your N/C program can be written, your tapes prepared and your personnel trained. In addition, your entire N/C program can be evaluated and your problems quickly resolved by the Consulting Engineering staff. This complete service is offered by Boeing, a pioneer in production use of Numerical Control and data processing and a recognized leader in the field. For professional, experienced assistance call or write: Robert C. Wilburn —Manager, Boeing Applied Computing Services, Wichita 1, Kansas. Let BACS put you in the lead.

TURN PAGE →

BACS

COMPLETE NUMERICAL CONTROL SERVICE

. . . Now available to all manufacturers

Boeing Applied Computing Services — with its incomparable experience in the field of cybernetics — can provide immediate quotations for your present and future Numerical Control requirements. Guaranteed tapes for N/C machines, including drawing data conversion, parts programming, computer usage, tape verification, tool and cutter design or parts fabrication and training are now available.

Whatever your needs BACS can offer professional, experienced assistance — from Consulting Engineering to Training.

'WALDO'

Wichita Automatic Linear Data Output

The problem of providing complete control media for N/C machines was solved by BACS with the development of WALDO — a fast and effective computer-assisted method of programming. Through use of WALDO, data for the Numericord (G. E.), Bendix, Milwaukee-Matic control systems and Probomat can be produced.

Computer-processed programs are now applied to the machining of tooling profile templates (for template-controlled machines), gages, three-dimensional contour dies, and other types of tooling. Production parts that are normally machined on hydrotels, routers, etc., or by making numerous set-ups on other conventional machines, have been produced in much less time on N/C machines with this program.

In the past three years, hundreds of tools and production parts have been fabricated using data processed through this computer program at Boeing-Wichita. Boeing's extensive experience in all phases of numerical control is now available to industry utilizing this type of equipment. BACS welcomes the opportunity to assist in the solution of your N/C problems.

BACS customers receive the flexibility of small business, combined with the stability and resources of a large business. BACS offers the following advantages:

1. Solutions to difficult problems are completed in an expeditious manner by qualified personnel with many years of experience.
2. Customers are members of a project team, and receive status reports as required.
3. All requests kept in strict confidence.
4. Each project completely controlled by one manager.
5. Tool Design—compatible with tape preparation.
6. Tool Fabrication.
7. Parts Fabrication.
8. Control Media Preparation.
9. Control Media Verification.
10. Complete Machine and Operator Instructions.

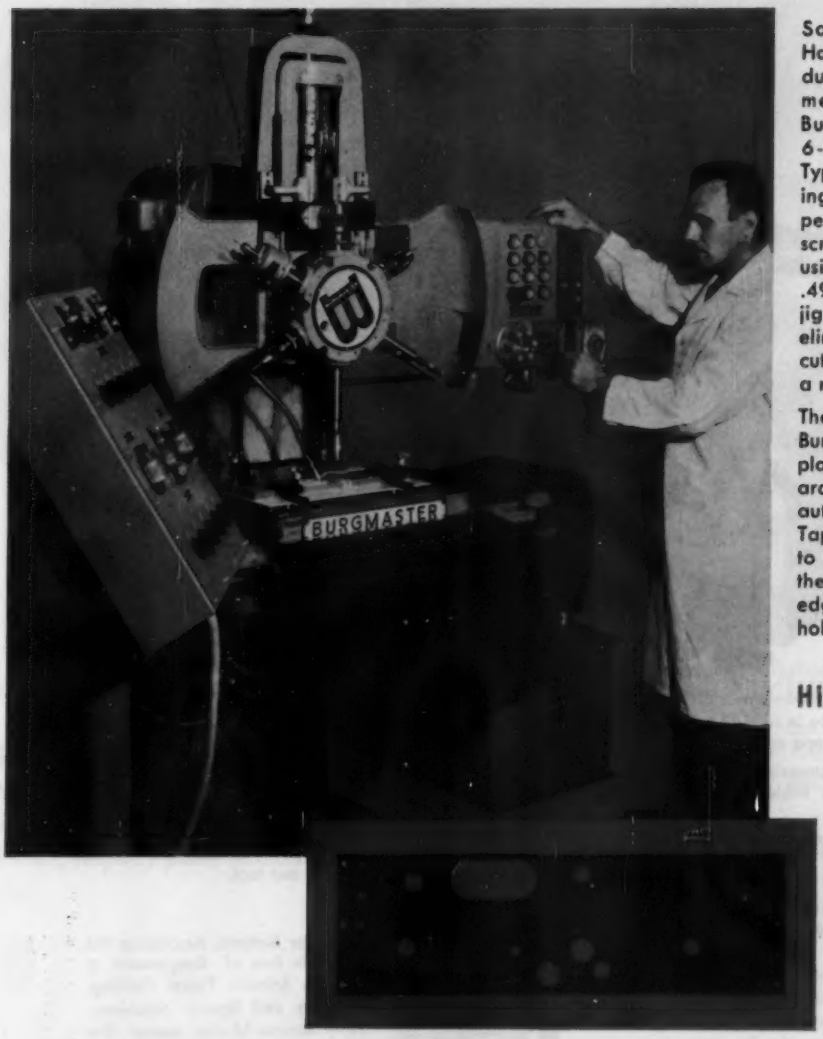
Upon the receipt of a request for services, an analysis of the requirements is made and a quotation returned within a few days. The quotation can be itemized in any manner that the customer desires.

For immediate action on your Numerical Control problems contact:

Robert C. Wilburn, Mgr., Boeing Applied Computing Services, 3801 South Oliver, Wichita 1, Kansas

BACS

PRODUCTION INCREASED 59%
$700 DRILL JIG ELIMINATED



Soundscriber Corporation, New Haven, Connecticut, is slashing production costs of Communicator Equipment Components with their two Burgmaster TAPE CONTROLLED 6-Spindle Turret Drilling Machine. Typical of these savings are the drilling, reaming and tapping operations performed on Panels used in Soundscriber Tape Recorders. Formerly, using six single spindle drills, it took .49 hrs./Panel, and required a $700 jig. The Burgmaster Turret Drill has eliminated the need for the jig and cut production time to .20 hrs./Panel, a rate increase of 59%.

The inexpensive setup shown on the Burgmaster consists of a simple subplate to mount the work, and standard clamps. Due to the completely automatic machining action of the Tape Controls, the operator is able to perform auxiliary functions during the machining cycle: deburring 8 edges on each Panel, deburring 50 holes, and gaging finished parts.

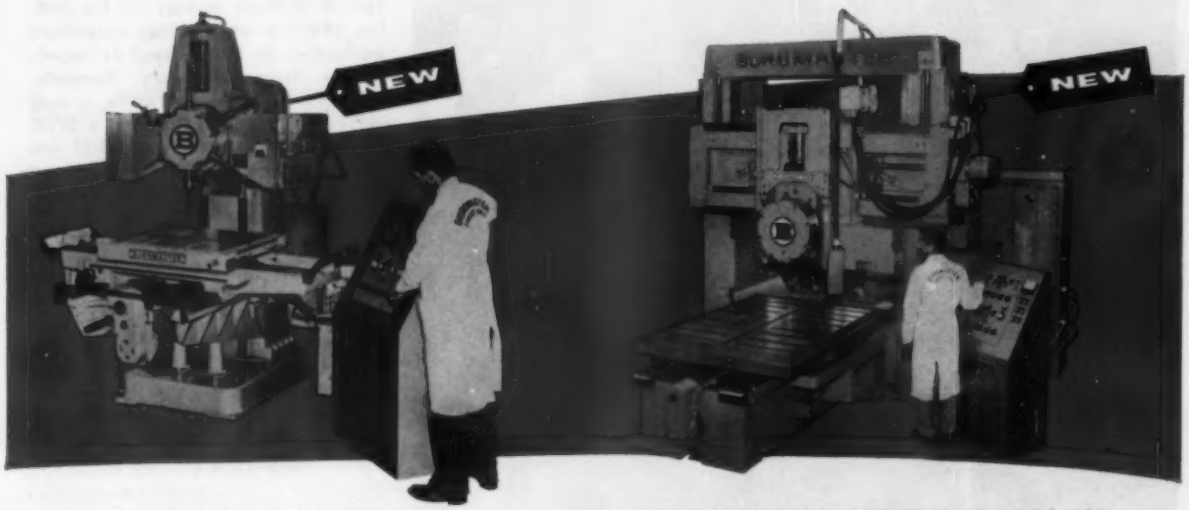
High Production with Low Cost Automation

Standard adjustable controls permit rapid setups from one part to another for most economical handling of small or large lots. Expensive jigs and fixtures are eliminated and the tape is easy to prepare — 4 holes per minute. The tape simultaneously positions the table within ±.001", selects the proper spindle and controls all machine functions. Preselective speeds, feeds and depth of cuts shift as the turret automatically indexes for highest individual tool efficiency.

Panels are 2024 T4 Aluminum 1/4" thick. Machining operations:
Drill 35 holes, tap 24 holes, 2 parts at a time.
Drill 15 holes, ream 1 hole, 3 at a time.
Holes and part edges are deburred by the operator during the automatic machining cycle.

For Complete Line of BURGMASTER Automatic Tape Controlled Turret Drills
Turn Page

The World's Most Complete Line of Turret Drilling, Tapping and Boring Machines



TAPE CONTROLLED MACHINES

Model 2BHT — 3/4" drill and tap capacity in steel; 2 hp; 10" x 18" positioning table; GE 2-axis tape control.

Model 2BHTL — 3/4" drill and tap capacity; 3 hp, 4-speed motor; 15" x 26" positioning table; GE 3-axis tape control.

Model 2BHTL — 3/4" drill and tap capacity; 3 hp, 4-speed motor; 15" x 26" positioning table; Hughes 3-axis tape control.

Model 25AHT — 1-1/4" drill and tap capacity in steel; 10 hp, 4-speed motor; 15" x 26" positioning table; GE 2-axis tape control.

Model 3BHT — 1-1/2" drill and tap capacity in steel; 15 hp, 4-speed motor; 20" x 30" positioning table; GE 2-axis tape control.

Model 3BHTL — 1-1/2" drill and tap capacity in steel; 15 hp, 4-speed motor; 30" x 45" positioning table; GE 2-axis tape control.

Model 3BHTB — double housing planer type; 1-1/2" drill and tap capacity in steel; 15 hp, 4-speed motor; 48" x 60" positioning table; GE 2-axis tape control.

WHAT BURGMASTER TAPE CONTROL MEANS TO YOU

Greatly reduced lead time — get into production in a few hours; Eliminates complex fixtures or index devices. Drill jigs and bushings not required; Much less spoilage on difficult jobs — machine does not depend on operator's skill; Greater accuracy — holds hole location to .001", repeatable to .0005"; Easy to program — 1 minute per hole location; Prepare tape — 4 holes per minute; Set-up machine — 3-5 minutes per tool.

Write for Bulletin describing the complete line of Burgmaster 6 and 8- Spindle Turret Drilling, Tapping and Boring Machines. Forty minute 16 mm sound film showing all Burgmaster Turret Drills in operation is available without charge.

BURG TOOL

MANUFACTURING COMPANY, INC.
15001 South Figueroa St., Gardena, Calif.
FAculty 1-3510 • DAvis 9-4158

BURGMASTER DIRECT SALES OFFICES: Ridgewood, N.J., 86 North Maple Ave., Gilbert 4-3002 • Chicago 5, Ill., 4908 Lincoln Ave., LOng Beach 1-1178 • Cleveland 7, Ohio, 14706 Detroit Ave., ACademy 6-3700 • Detroit 37, Mich., 13730 W. Eight Mile Rd., Lincoln 8-4333 • San Francisco, Calif.

Plus dealer representatives in other industrial centers.

CIRCLE 300 READER SERVICE CARD

New Carlton Controls Corporation Numerical Control available for new point-to-point positioning machine tools

SEE IT IN ACTION

New CCC numerical control will be in operation at The CARLTON Machine Tool Company plant in Cincinnati.

Would modern point-to-point positioning give your machine tools a welcome sales lift? You can get it now . . . made to order for you by Carlton Controls Corporation . . . a new numerical control system ready to be installed on new machine tools, even those now on your assembly floor.

The new CCC system brings automatic operation to standard machine tools. It offers:

1. Tape control for automatic 2- or 3-axis positioning of tool, plus automatic speed-feed changes. Tape is standard 1" wide 8 channel.
2. Keyboard for separate non-taped operations provides manual input of 5- or 6-digit numerical data for each axis. Numerical values, actuated by keyboard or tape, are presented visually by indicator lights.
3. Zero offset establishes new starting point from the workpiece regardless of location.

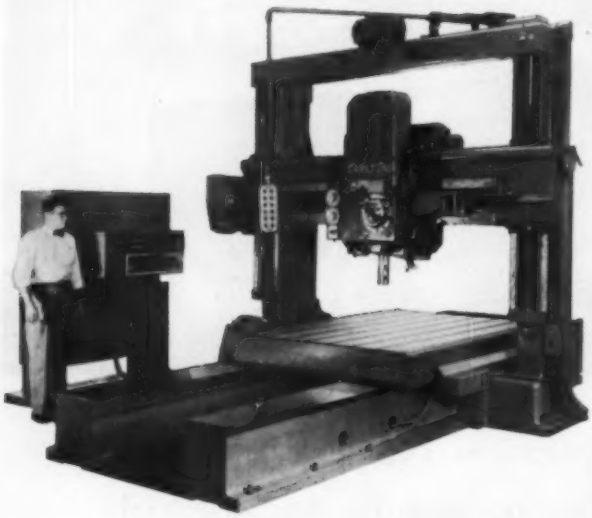
Machine tool manufacturers can obtain complete information on the new CCC numerical control by writing:

THE CARLTON MACHINE TOOL CO.
Cincinnati 25, Ohio

Carlton

Specialists in boring and drilling machines

VERTICAL DRILLING AND BORING MACHINE



***with numerical control* for automatic positioning. Accurately locates work for boring, reaming, drilling and tapping.**

Specifications	*3ARS*
spindle diameter (driving dia.)	3-3/16"*
vert. travel rail on box posts	45"
vert. travel spindle in head	18"
distance, spindle to table min.	12"+
distance, spindle to table max.	50"+
horizontal travel of head on rail	48" to 66"‡
transverse travel table on bed	48" to 120"
spindle speeds, number	36
spindle speeds, range rpm	100 to 1
feeds, including tap leads, number	18
feeds, range	.004 to .125
motor recommended, hp	10-15

*available with 4" spindle
+ spindle retracted in head
‡in 6" increments

HORIZONTAL DRILLING AND BORING MACHINE

***with numerical control* . . . for tape, keyboad or pushbutton control. Allows any shop to automate boring, drilling, reaming and tapping.**

- **head and saddle movements numerically controlled.**
- **spindle axis numerically controlled, optional.**
- **operator's station centrally located on head.**
- **responsibility vested in Carlton for machine and control.**

Specifications	*2H*	*4H*	*5H*
spindle diameter (driving dia.)	2-11/16"	4"	5"
vertical travel head on column, maximum	72"	96"	156"
horizontal travel saddle on bedplate to suit individual requirements			
travel of spindle in head	15"	30"	42"
distance, floor to spindle	28"	35"	36"
overall height, maximum	124"	184"	246"
spindle speeds, number	12	36	36
spindle feeds, number	6	18	18
motor recommended, hp	5-10	10-25	15-40

optional speed and feed ranges available for any of these machines

THE CARLTON MACHINE TOOL CO.

Cincinnati 25, Ohio

free analysis of your tape requirements

point-to-point or continuous path positioning

dial-in control of 2 axes, or tape control of 2, 3, or 4 axes

tape control of all speeds, feeds, depth, and clamping

exclusive Di-Matric controls provide infinite machining cycles

tape-revolved tables with infinite positions or radial feeding

automatic power tool lock with hardened and ground taper

automatic tape controlled tool changers available

all drive screws in center of guideways for best accuracy, least wear

tape is read during positioning; no delays

simple switching from tape to pendant controls

heavy-duty, rigid structural design

repeatability within plus or minus .0001"

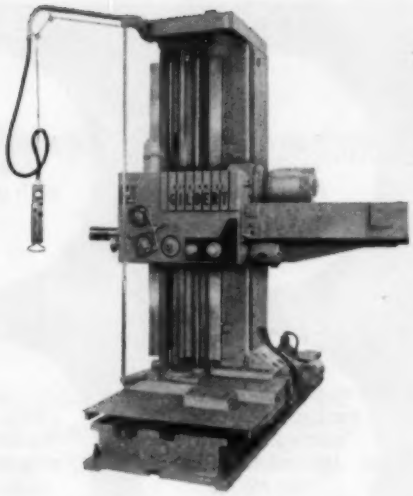
wide range of sizes, both table or floor type

14 reasons to consider tape-controlled Gilberts

Summarized here are the main reasons you should consider Cincinnati Gilbert's numerically-controlled 4" and 5" horizontal boring mills. We suggest a letter or phone call for complete information—or, better yet, a visit to the plant to see an actual demonstration. The Cincinnati Gilbert Machine Tool Co., 3366 Beekman Street, phone KIrby 1-4815, Cincinnati 23, Ohio.

GILBERT

With a camera replacing the spindle head, this tape-controlled Gilbert positions in 3 axes to a guaranteed accuracy of ±.0005" (actually inspected to ±.0001"). With all drive screws in the center of guides, this machine will maintain its accuracy for years.



Several different work stations can be combined with this new 4" floor type machine to multiply your productivity. Column heights and runway lengths may be chosen to fit your requirements. Dial-in, 2, 3, or 4 axes numerical controls are available.

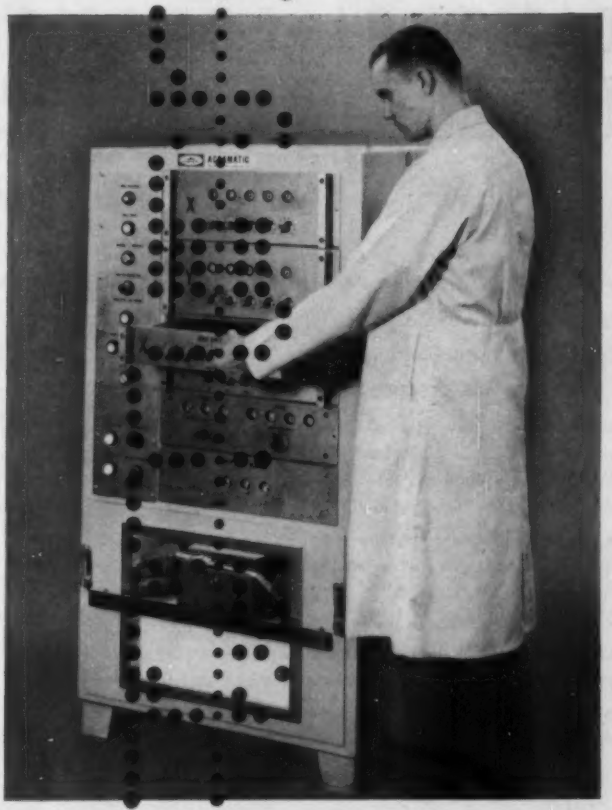
This new 4" boring mill is specifically designed for numerically-controlled positioning and contouring, and for tracer controls. Many combinations of table, saddle, bed, and column sizes can be selected to suit the dimensions of your work.

Cincinnati Gilbert power revolving tables may be tape-controlled to give you a fourth axis. They are built with either round or square tops in a range of standard sizes. Special tables can be engineered to meet unusual specifications.

GILBERT

CINCINNATI MILLING ANNOUNCES CIMTROL DIVISION

... offering machine control systems for original equipment builders



ACRAMATIC *2-Axis Simultaneous Positioning System, demonstrating the convenience of modular construction*

As long ago as 1912, Cincinnati Milling engineered automatic controls for milling machines. The first unit, an automatic cycle feed box, was followed by many unique types of hydraulic, electronic and electro-hydraulic controls and systems for milling, grinding, die sinking, broaching and special machines built by Cincinnati.

So important is this technology today that Cincinnati has established the CIMTROL Division. The only full line manufacturer of machine control systems, this new Division is responsible for engineering, manufacturing, marketing and servicing of controls for application in products of original equipment builders. The CIMTROL line includes ACRAMATIC Numerical Control, ACRATRACE Tracing Systems and ACRASIZE Gaging Systems.

What are *your* machine control problems? CIMTROL engineers have the background and the facilities to help you work out the best solution.

CIMTROL DIVISION
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

CIMTROL CINCINNATI®

CIMTROL ACRAMATIC

ACRAMATIC

NUMERICAL CONTROL SYSTEMS

2-Axis Simultaneous Positioning Control embodies all the features necessary to take full advantage of the accurate positioning, automatic cycle programming, and operating efficiency possible with numerically controlled production.

ACRAMATIC Numerical Control Input is prepared on standard 1" wide 8-track perforated tape, using EIA standard coding. Tapes may be prepared and reproduced on many different models of office tape punching equipment.

Multiple functions such as coolant flow, depth stops, spindle speeds and feeds, and other elements of automatic cycles can be controlled by the tape.

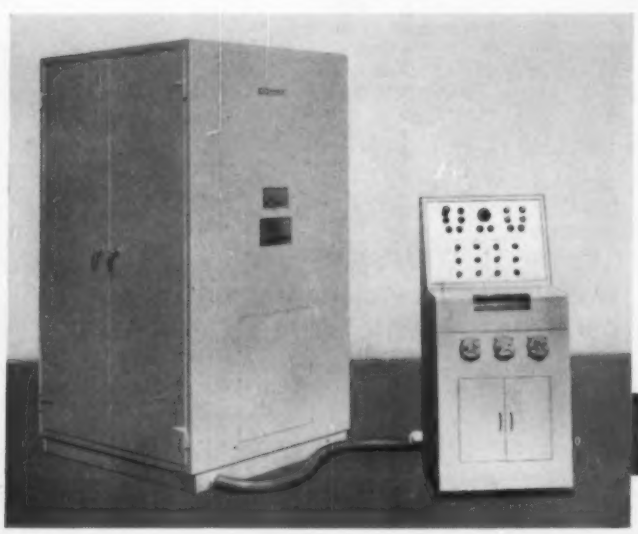
Direct numerical readouts of speeds, feeds, operation number, and coordinate positions are available. In addition, the numerical information to position the machine may be manually dialed in.

Electro-hydraulic continuous servo systems are used for each axis, promoting the greatest accuracy and speed of operation.

Full range zero shift, using calibrated handwheels, moves the programmed dimensions into alignment with the part anywhere within the working range of the machine. This feature reduces setup time to a minimum.

Complete information on the foregoing system applied to a Heald Drilling Machine will be found in ACRAMATIC data sheet No. CD-6A.

Contouring Control System employs a unique analog ratio feedback system to translate smooth continuous movement of a precision slide into an equally smooth continuously changing voltage ratio, free from pulses. Each position along the slide motion has its own electrical equivalent. The location of the tool is always electrically as well as mechanically positioned with respect to a specific origin. This relation cannot be lost even if the entire control is shut off.



ACRAMATIC Numerical Control Input is in the form of an 8-track, 1" wide perforated tape, using the EIA standard code. Punched card input is also available.

Parabolic interpolation means less input data must be processed. Compared to systems which approximate a curve by a series of closely spaced straight lines, ACRAMATIC can often produce the same degree of accuracy with a reduction of input data of 10 to 1 or more.

Feed rate override, from 0 to 100%, permits the operator to make on-the-spot adjustment of feed rate. If need be, this feature can be blocked out by the programmer.

Zero shift is provided by a group of calibrated 10-position switches arranged in decade fashion.

Exclusive cutter compensation eliminates re-programming for cutters of varying OD.

Discretionary exit from programmed path at any point, and automatic push-button realignment at exactly the same point.

Complete information is contained in ACRAMATIC data sheet No. CD-8.

CINCINNATI®

CIMTROL DIVISION, THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

FOSMATIC N/C TURRET DRILL

The drill that carries its own "tool crib". Machine hundreds of different parts without changing tools. Full 3-dimensional tape control including rapid tool selection with the 32-spindle turret. Combined General Electric Mark II and Fosmatic numerical control makes this unique, heavy-duty machine an efficient producer for drilling-tapping-milling with lot sizes as small as one!

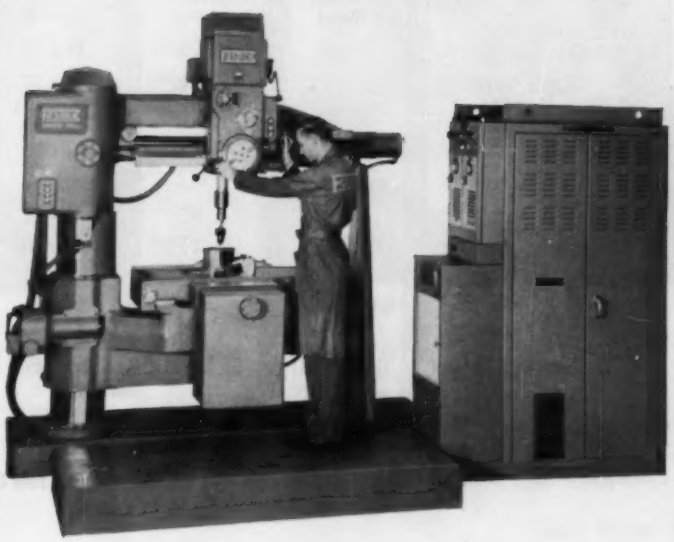
NUMERICAL CONTROL *for more effective, lower cost*

DRILLING • TAPPING • MILLING

Get a proposal from

FOSDICK

THE FOSDICK MACHINE TOOL CO., CINCINNATI 15, OHIO



FOSDICK N/C LAYOUT DRILL

Keep costs low with this economical machine built to speed drilling and tapping jobs through your shop. Great versatility. Simple in concept, easy to operate. Proven, fast General Electric Mark II numerical positioning control, with full zero offset. The best buy in numerically controlled drills.

See specifications on other side.

CIRCLE 307 READER SERVICE CARD

NUMERICAL CONTROL FOR PRODUCTIVE PRECISION BORING

FOSMATIC N/C PRECISION BORING MACHINES

Four models from the compact "32" with 18″ x 30″ table travel, to the big "54" with 28″ x 48″ travel. All available with Fosmatic electro-mechanical tape control for table position, spindle depth, head height, speeds, feeds, and tool changing. Fosmatic control positions workpiece accurately to ± .0001″. Fosmatic jig borers make provision for numerical control in the basic design and can be furnished in any degree of automation. See specifications below.

SPECIFICATIONS: FOSDICK NUMERICALLY CONTROLLED MACHINES

	N/C TURRET DRILL	N/C LAYOUT DRILL	N/C PRECISION BORING MACHINES (Jig Borers)			
			Model 32	*Model* 42	*Model* 44	*Model* 54
Table working surface, in.	18 x 31	24 x 42	18 x 32	18 x 42	44 x 22	54 x 22
Table travel, in.	18 x 24	18 x 32**	18 x 30	20 x 36	22 x 42	28 x 48
Spindle nose to table, in.	3 - 23	3 - 23½	4 - 22½	4 - 28½	6 - 30	6 - 30
Spindle center to column, in.	19½	9 - 43	16½	16½	18½	18½
Head or knee travel, in.	12	16½	9½	15½	15	15
Spindle travel, in.	8	12	9	9	9	9
Spindle speeds, rpm	65 - 2500	75 - 1500*	62 - 3000	62 - 3000	30 - 1800	30 - 1800
Spindle feeds, ipr	.0006 - .012	.004 - .020*	.0005 - .015	.0005 - .015	.0005 - .015	.0005 - .015
Motor hp.	3	3	3	3	3	3
Numerical control	GE Mark II —Fosmatic	GE Mark II	Fosmatic	Fosmatic	Fosmatic	Fosmatic

*other ranges available **travel of head on arm

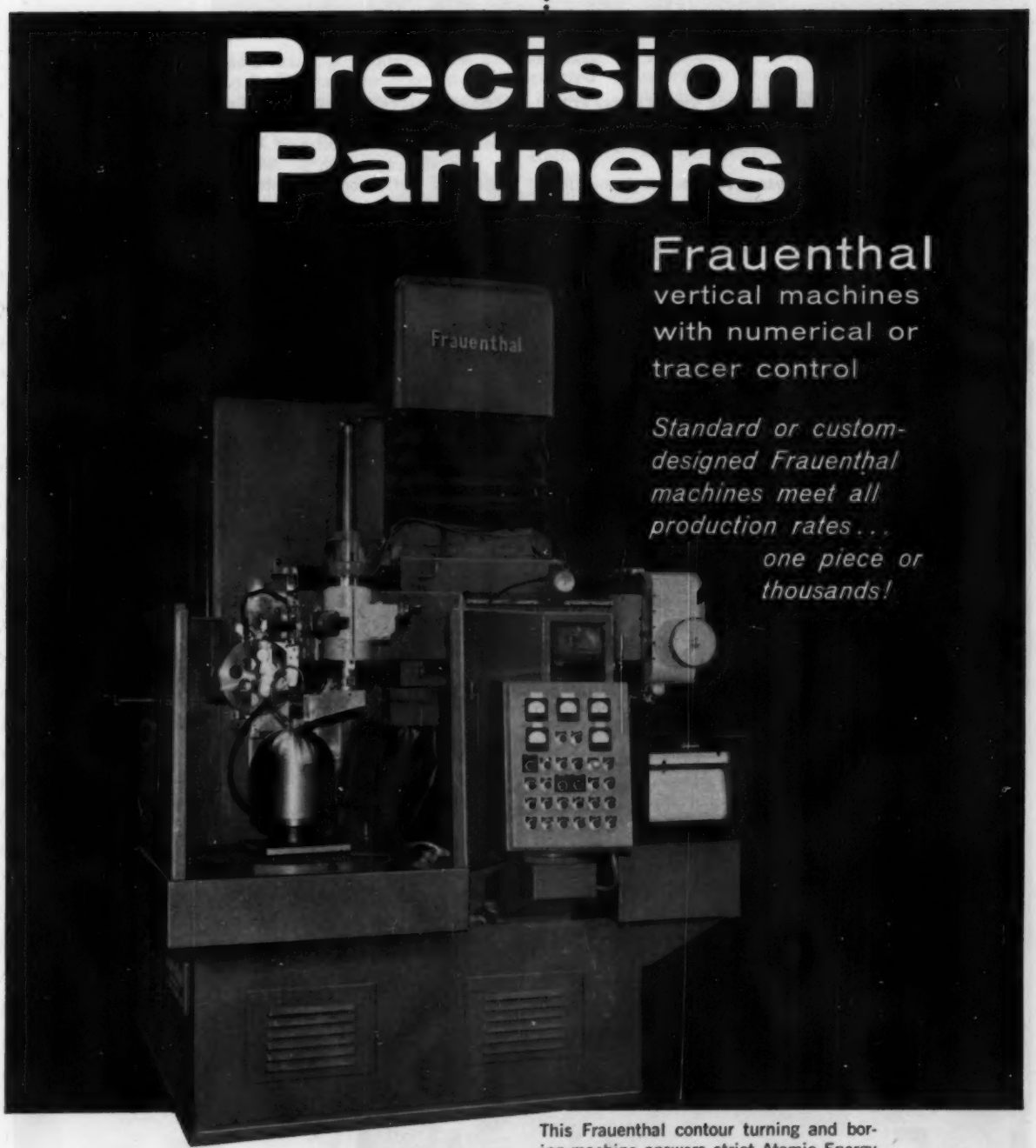
The Fosdick Machine Tool Co., Cincinnati 23, Ohio FOSDICK

Precision Partners

Frauenthal

vertical machines with numerical or tracer control

Standard or custom-designed Frauenthal machines meet all production rates... one piece or thousands!



This Frauenthal contour turning and boring machine answers strict Atomic Energy Commission requirements for ultraprecise accuracies. It can be used with numerical or tracer control for close-tolerance grinding assignments.

Contour turning accuracy to ±.000150"—even on 30" diameter work pieces

Turn Page →

Frauenthal

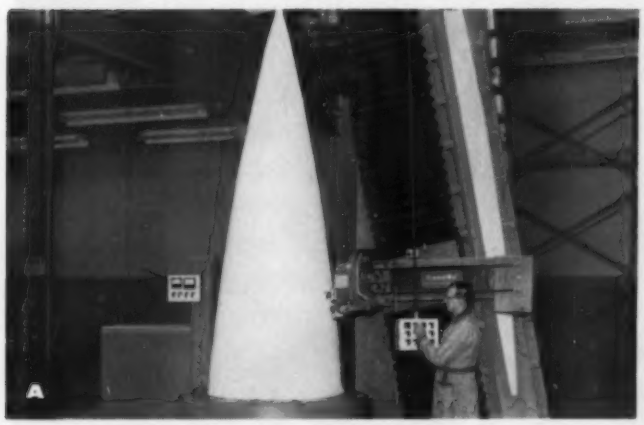
vertical machines for standard and contour grinding, turning and boring... with numerical or tracer control

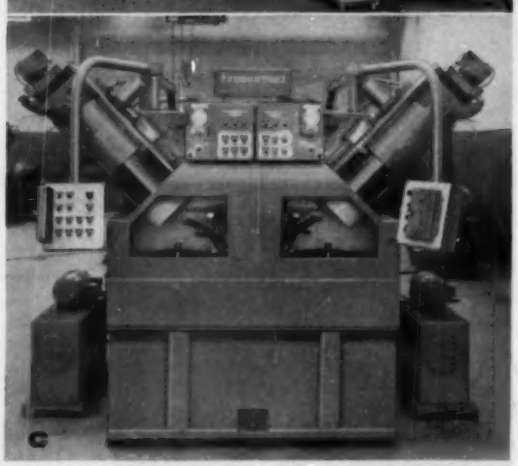
Whether machining a missile nose cone with a highly critical tolerance, or turning out automotive parts on a production-line basis, a Frauenthal **vertical machine** keeps every piece "on target."

Ultraprecise machining accuracy is built into Frauenthal machines — with either numerical control or a transistorized, electronic-hydraulic tracer system.

Frauenthal design versatility is outstanding, too. Using "building-block" construction, Frauenthal machines easily adapt to contour and conventional grinding, turning, boring, milling, facing, or polishing.

And vertical design of the Frauenthal machines eliminates the deflection encountered when large, unsupported parts are machined in a horizontal position. This design provides easier loading, faster centering and checking of parts, and substantially reduced floor-to-floor time.





A Large O.D. nose cone grinder for precision winding and grinding of filament-wound fiber-glass radomes.

B Special O.D. and I.D. bearing race grinder for ultra-precision finishing of steel mill hydrostatic bearings.

C Twin-table, dual-spindle automatic production machine used to grind the face and hub of automotive transmission housings.

Frauenthal
DIVISION
THE KAYDON ENGINEERING CORP.
MUSKEGON, MICHIGAN, U.S.A.

Designed and built in the U.S.A. You support American industry when you specify Frauenthal.

D-6011

FOR THE COMPLETE TAPE CONTROL "PACKAGE"

Machines. A complete new line designed and built from the floor up to be operated under numerical control — horizontal boring, drilling, and milling machines . . . vertical boring and turning machines . . . combination jig borer-milling machine . . . contour milling and die sinking machines . . . positioning tables . . . planers . . planer mills.

Controls. The system of your choice, including Numeripoint* and Numeripath* controls of G&L design and manufacture to give you maximum productivity in point-to-point positioning or path machining.

Cutting tools and toolholders. A complete line of Davis pre-size VBM and VTL tooling . . . boring tools . . . arbors, sleeves . . . continuous-feed facing heads . . . tapholders for machines without thread leads . . . and special tools.

Accessories and attachments. Rotary tables, angular milling attachments, box-type angle plates, V-blocks, stop and jack blocks, measuring devices, and other equipment for speeding setups and production.

Fixturing service. Special holding fixtures designed and built to meet your specific requirements.

Tape control training. G&L trains your operators when the machine is installed, teaches existing personnel how to program and prepare tapes, provides in-plant instruction of your maintenance men and conducts service training schools at Fond du Lac.

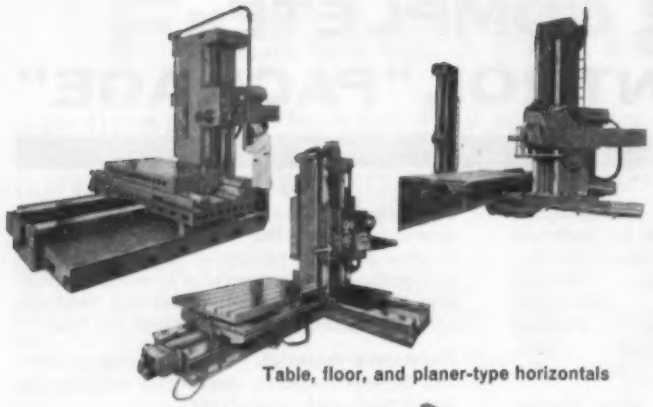
Reference material. Programming and control system manuals thoroughly explain the equipment and procedures.

Consultation. Giddings & Lewis built the first commercially available tape-controlled machine tool, has shipped more major machines with numerical control than any other builder, uses tape control extensively in its own shops. The know-how gained from this experience is available to help you justify, select, and apply numerically controlled machines for maximum manufacturing and economic benefits.

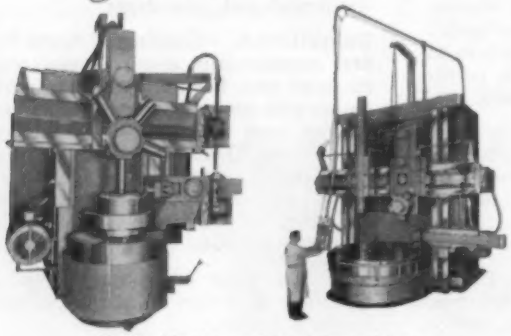
Turn the page for a quick rundown on Giddings & Lewis numerically controlled machine tools.

GIDDINGS & LEWIS

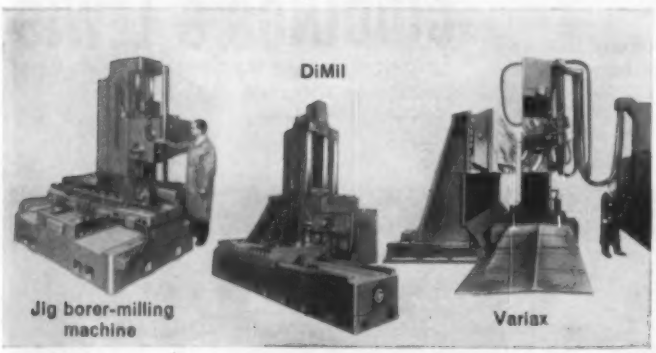
GIDDINGS & LEWIS MACHINE TOOL COMPANY
Fond du Lac, Wisconsin
*Giddings & Lewis trademark

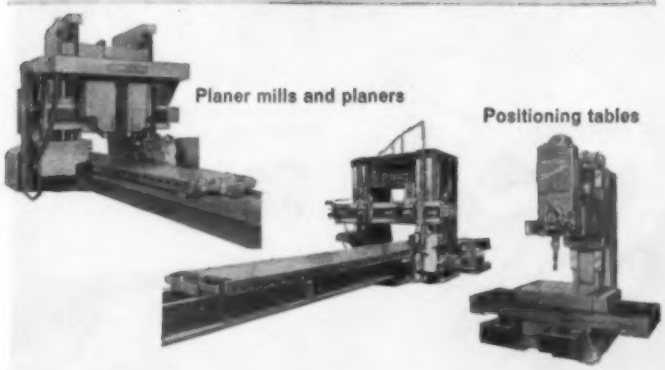


Table, floor, and planer-type horizontals



Vertical boring and turning machines





Giddings & Lewis

...first in machine tools specifically designed and manufactured for numerical control

Horizontal boring, milling, and drilling machines — 3″ to 14″ spindle diameters standard. Table, floor, planer types — 10 to 150 hp — positioning or contouring control.

Vertical boring and turning machines — 32″ to 20′ table sizes — up to 125 hp — positioning or contouring control.

Jig borer and milling machine — 3″ spindle machine designed and built to position to ± .0001″ with consistent repeatability under Numeripoint control.

DiMil — Horizontal spindle die sinking and contour milling machine — 10 and 20 hp, table and floor types — operated by Numeripath tape control systems.

Variax machines — Two, three, four, and five-axis contour milling machines — 360° profiling — Numeripath controlled.

Planer mills — 36 to 144″ table widths standard — up to 125 hp per head — positioning or contouring tape control.

Planers — Openside and double housing — 30 to 144″ table widths standard — up to 150 hp — punched tape automatic control.

Positioning tables — Two-axis — five-ton capacity — 38 x 50″ to 38 x 102″ sizes — punched tape control.

Call your Giddings & Lewis distributor or write to the factory for descriptive literature and details on Giddings & Lewis numerically controlled machines.

GIDDINGS & LEWIS

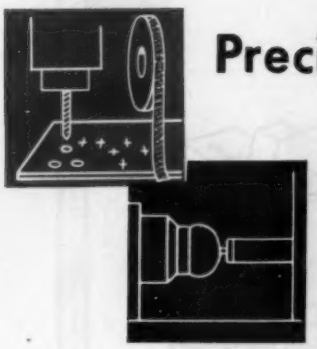
GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond du Lac, Wisconsin

Jig borer and milling machine; horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; positioning tables; die sinking machines; contour milling machines; radial and upright drilling machines; planers; planer mills; numerical and tracer control systems; Davis boring tools.

GIDDINGS & LEWIS

T-101

HEALD equipment for NUMERICALLY-CONTROLLED



Precision Drilling

and

(See next page)

Contour Borizing

Where To Use Numerical Control

The advent of numerical control offers many new opportunities for cost savings. How far this new technology can be profitably applied depends on many factors, all of which your HEALD engineer is well qualified to help you evaluate. In general, however, numerical control will usually be most advantageous in the following applications

1. Where several different setups are required
2. Where workpieces or operations are complex
3. Where manual setup time is relatively high
4. Where tooling time must be reduced
5. Where variety of work requires excessive fixture and tooling inventories

Completely New

HEALDRILL

. . . the latest advance in the art of high-precision layout or production drilling, reaming, tapping, spot facing and light boring

The ruggedly-built HEALDRILL includes tape control of table positioning, speeds, feed rates, automatic "Z" axis feed and return to any of six stops on depth control turret and tool-change indication. When a series of holes of the same size are to be drilled, counterbored or reamed, the cycle is fully automatic.

Available with "Acramatic" punched tape control by The Cincinnati Milling Machine Company, the HEALDRILL permits simple, direct programming of all functions—tape reading rate of 1200 lines per minute — full range zero shift on both axes — repeatability of ± .0002" — accuracy of positioning to ± .001" and complete manual control from the console when tape is not used.

A two-axis positioning control of the analog type, the Acramatic system is relatively simple in both operation and maintenance since it consists mostly of standard magnetic and electrical equipment. The system is described as "absolute," since all coordinates are from a given reference point and there is no accumulation of error.

SPECIFICATIONS

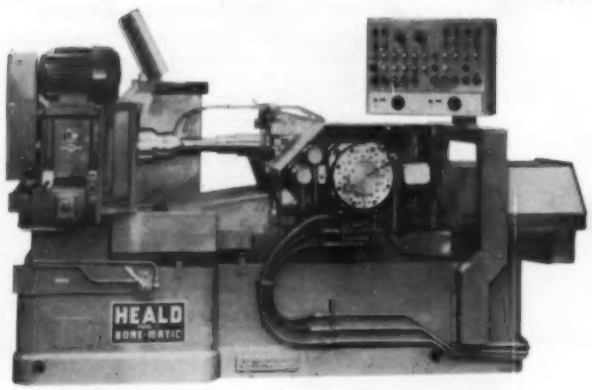
Table Size	24" x 56"
Longitudinal Table Travel	48"
Traverse Table Travel	20"
Vertical Range	0-30"
Spindle Speed Range	30-1800 rpm in 16 steps
Feed Range	.002"-.030" per rev. in 8 steps

THE HEALD MACHINE COMPANY • Worcester 6, Mass.

Numerically-controlled

MODEL S BORE-MATICS

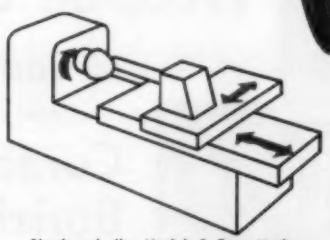
for fully automatic, high precision contour boring and turning



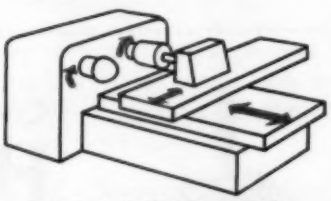
On the new, numerically-controlled Heald Model S Bore-Matics, contoured parts are borized in production with a heretofore unattainable degree of accuracy and precision. Tool motion and work speed are automatically controlled throughout the entire cycle, in increments so small that contours are generated with a dimensional tolerance of ± .0001".

The machine shown above, with 20" table stroke and 15" cross slide travel, is arranged for punched tape control using Cincinnati Milling Machine Company's "Acramatic" system. Table and cross slide are actuated by preloaded, recirculating ball nut precision lead screws with hydraulic motor drive. Pressure lubricated box-type ways track to an accuracy of 30 millionths in 20 inches of travel. The specially designed work spindle turns within 30 millionths for total runout, and is driven by a cam-controlled variable speed unit arranged to maintain the proper cutting speeds for any given point on the workpiece contour.

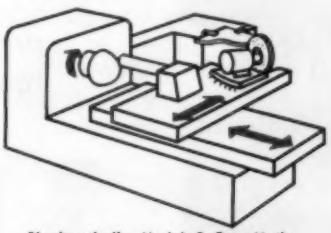
These Model S machines have been supplied in several different types, as shown by the drawings at the right, and are now in successful operation on a number of classified projects.



Single-spindle Model S Bore-Matic for precision contour turning or boring. Arrows indicate tape-controlled motions.



Two-spindle Model S Bore-Matic for sequential contour boring and turning.



Single-spindle Model S Bore-Matic for combined contour turning or boring and contour grinding of templates.

Numerically-Controlled Fixture Indexing

This Heald precision rotary indexing fixture, with tapeless electronic numerical control, makes it possible to divide a circle into anything from 4 to 524,000 equally spaced segments without the use of interchangeable master plates. The operator need only "dial in" the hole spacing and the fixture does the rest.

It Pays to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

HEALD®

NOW...TAKE A CLOSE LOOK AT THE HILLYER

THE HILLYER—YEARS AHEAD IN ENGINEERING AND PERFORMANCE AT LOW COST

The Hillyer machine of today is the result of specialized experience in developing and building tape-controlled machine tools, which goes back to the first numerically controlled machines in industry.

The design and performance of the Hillyer are superior in every way, and because Hillyer is devoted exclusively to the manufacture of tape-controlled machine tools, this high quality is available at low cost. Look at all the other tape-controlled machines carefully — Then take a close look at the HILLYER.

FULLY CONTROLLED

Speeds, feeds, depths, auxiliary functions and positioning are **all** fully controlled by both tape and dial. Choice of 1" or 4" tape.

ACCURATE, FAST

Holes located and drilled to accuracies of .001 inch per foot, with repeatability of .0005 inch, and rates up to 15 holes per minute.

RUGGED, COMPACT

Rigid bridge-type construction, with machine and controls built as one unit, utilizing total floor space of only 82" x 78".

FLEXIBILITY

Unusual ease of operation, with simplified control panel. You can switch from tape to dial in seconds, in any part of the program, with no loss in positioning accuracy.

SINGLE RESPONSIBILITY

Machine and tape control both designed and built by Hillyer, as a completely integrated, fully automatic, trouble-free machine tool.

RELIABILITY, SERVICE

Simple electrical circuitry throughout, easily maintained by your own regular personnel. Factory service when desired, within 24 hours.

These features, plus the Hillyer's larger table sizes and wider drilling ranges, add up to "more for your dollar with the Hillyer." Find out first what other tape-controlled machines offer, at higher prices — then take another close look at the Hillyer.

Because Hillyer manufactures all three types — single spindle, turret, and automatic tool changer models — Hillyer will recommend the right machine tool for your application. Ask for a demonstration.

BASIC SPECIFICATIONS
(Before addition of optional features and equipment)

	SINGLE SPINDLE MODELS	TURRET MODELS
RANGE		
Positioning Range	24"x24" or 36"x24"	24"x24" or 36"x24"
TABLE		
Overall Table Size	36"x30" or 43"x31"	36"x30" or 43"x31"
SPINDLE		
Taper	#2 M.T. or #4 M.T.	#2 M.T.
Standard Feed		
Stroke Length	4" and 8"	4"
Spindle Motor		
Horsepower	1, 2 or 3	1 or 2
Drilling Capacity		
in Steel	5/8" to 1¼"	½" to ⅞"
WAYS		
Overall Accuracy— Straightness and Parallelism	Hardened and Ground to .0002"	Hardened and Ground to .0002"
FLOOR SPACE		
Area	82"x78"	82"x78"
POSITIONING SYSTEM		
Positioning Accuracy	.001" per ft.	.001" per ft.
Repetitive Accuracy	.0005"	.0005"
Traverse Speed	100" per min.	100" per min.

Drilling steel tube sheet on round-the-clock basis. Production rate increased by over 300%.

Production of precision gyro part increased over 400%. Accuracy is very vital machining factor.

OPTIONAL EQUIPMENT

1" or 4" Tape • Tapping Control • Milling Control • Dwell Control • Peck Drilling Control • Coolant System • Drill Guide Bushing Holder • Raising Blocks • Direct Recording Tape Punch

OTHER HILLYER TAPE-CONTROL PRODUCTS

High Speed Printed Circuit Drilling Machine • Tape-Controlled Rotary Table • Automatic Tool Changer • Heavy Duty 1¾" Capacity Drilling and Boring Machine

Hillyer

331 CENTENNIAL AVE., CRANFORD, N. J.

Hughes two-axis control system, with positioning table, can be retrofit to almost any kind of drilling machine—single or multiple spindle—or to any other type machine requiring two-axis positioning.

Hughes numerical controls will reduce lead time, eliminate complex jigs and expensive tooling, and increase the productivity of your machine. And, they are easy to operate and service!

The Hughes Positioning Table is automatically operated from pre-programmed taped instructions. The table positions at a rate of 150 inches per minute; has repeatable accuracy to within 0.0002". Measuring circuit and drive motors are fully integrated.

Installation of this proven system is simple and fast. In many cases, all it takes is one day.

To find out more about how Hughes numerical controls can increase your profits, write, teletype (TWX INGL 4117) or call collect: Hughes Industrial Systems Division, P.O. Box 90904, International Airport Station, Los Angeles 45, California. For export information, please write: Hughes International, Culver City, California.

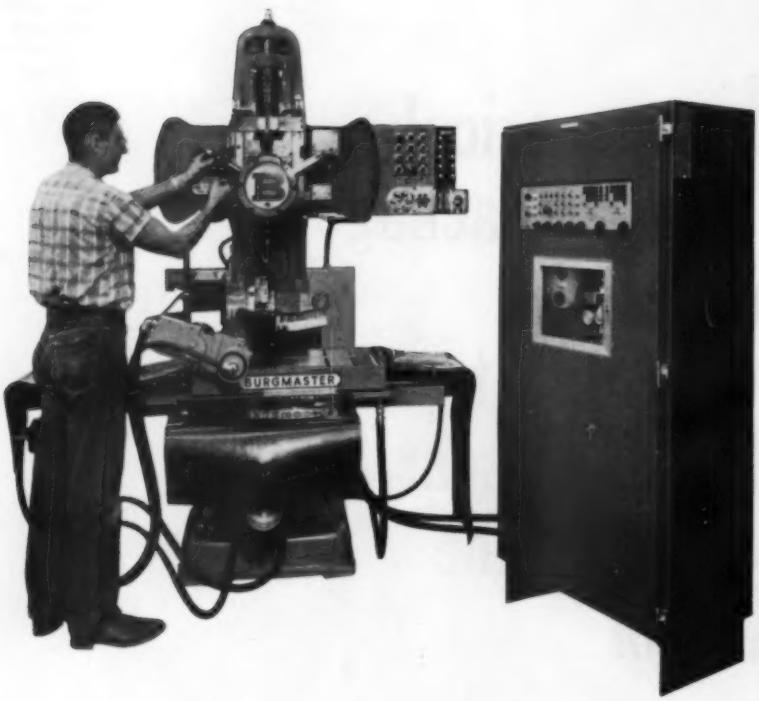
Creating a new world with ELECTRONICS

HUGHES

INDUSTRIAL SYSTEMS DIVISION
HUGHES AIRCRAFT COMPANY

NOW! a numerical control package that can be retrofit to your present machine tool

lead time cut over 50%— $3,000 saved on tooling with Hughes Tape Controlled Burgmaster



PROBLEM: To drill, countersink and tap 69 holes, including radial locations, to close tolerance in 50 missile bulkheads.

SOLUTION: Hughes All-Electronic Numerical Controls, a precision Rotary Table, the Burgmaster Turret Drill with two-axis positioning table, and existing simple fixtures and clamps. The need for complex multi-base drill jigs and other expensive tooling was eliminated.

RESULT: Hughes Tape Controlled Burgmaster saved over $3,000.00 in tool design and manufacturing time. Lead time was reduced by five weeks.

Hughes All-Electronic Numerical Controls are completely transistorized—and are immediately available for use on new machines or for retrofit of older units. These controls are now offered as standard equipment with Burgmaster Turret Drilling Machines.

For more information on how you can increase your profits with a Hughes Tape Controlled Burgmaster, contact your local Burgmaster Representative. Or, write:

HUGHES Industrial Systems Division, P.O. Box 90904, International Airport Station, Los Angeles 45, California.

For export information, write: HUGHES International, Culver City, California.

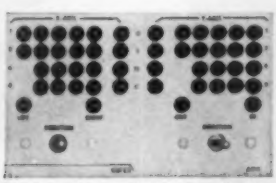
Creating a new world with ELECTRONICS

HUGHES

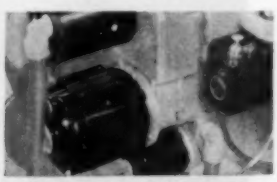
INDUSTRIAL SYSTEMS DIVISION
HUGHES AIRCRAFT COMPANY

Trouble-free operation; easy electrical maintenance: Transistorized circuitry and modularized construction assures you uninterrupted production with low power consumption; simple replacement and repair. *No service contract needed!*

Longer tape life with extra accuracy: Sensitive photo-electric tape reader eliminates deformation of tape holes; reduces possibility of tape wear and tearing. No pneumatic or hydraulic connections required for tape reading operation.



Easier set-up and program checking: Display lights on control panel indicate coordinate dimensions enabling operator to verify the accuracy of programming quickly and easily. Control panel human-engineered for maximum efficiency in operation.



Fast, accurate positioning; easy mechanical maintenance: Drive package positions table at 180 inches per minute; repeatable accuracy: ±0.0002", non-cumulative. Use of standard industrial electric motors and clutches assures quick repairs.

JONES & LAMSON
"AUTOMATION"

the man who needs
a new machine tool is
already paying for it

Major savings on every job during first full year of tape control operation

At The Goss Company, a division of Miehle-Goss-Dexter, Inc., Chicago, tape control machining plays an important part in the over-all production operation.

For instance, this J & L tape-controlled positioning table, equipped with a standard column drill press, has achieved an average of 30 to 40% savings in floor-to-floor time on every job assigned. One job, involving drilling and reaming of small malleable iron transfer roll adjusting plates, was transferred from a conventional sensitive drill press setup to the J & L machine. Job lots consisted of only four pieces.

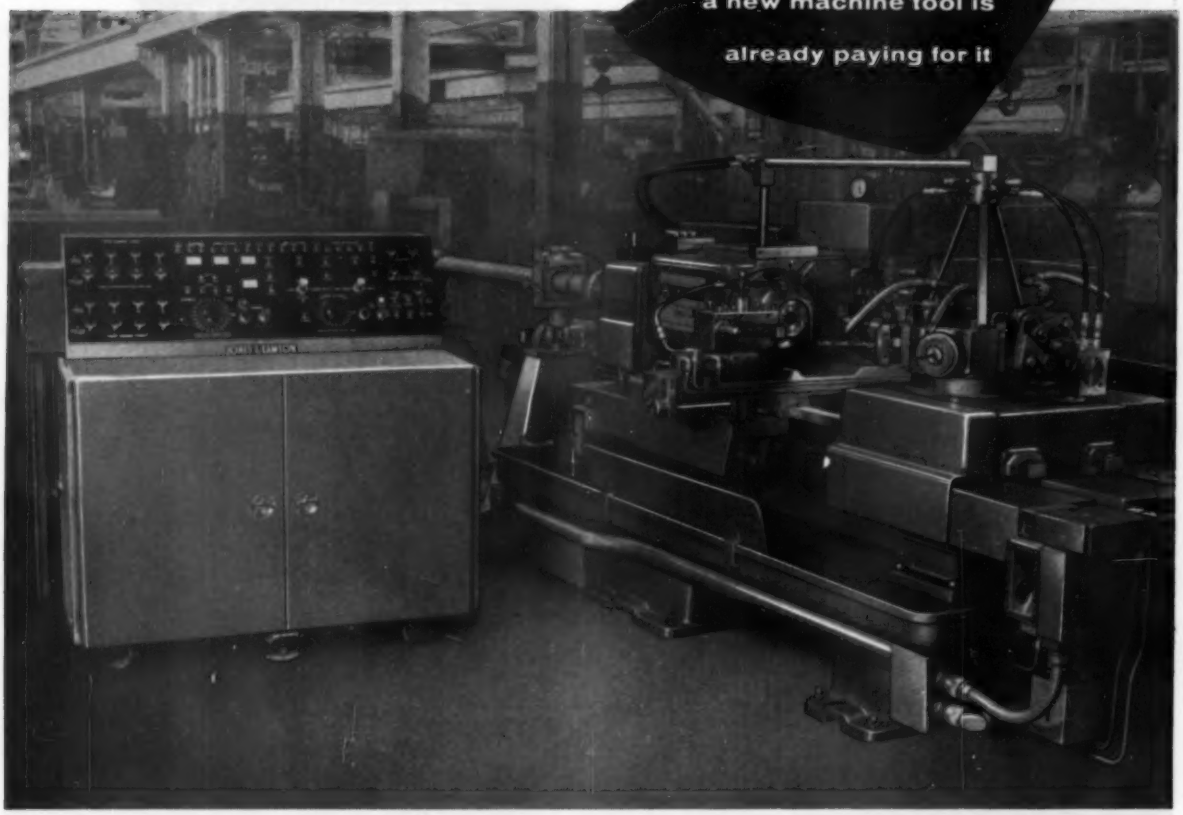
The old setup required 3.1 hours production time for each lot. Using tape control, with a simple locating and clamping setup, Goss has been able to cut this time to 1.7 hours—a saving of 1.4 hours per lot, or more than 45%. Hole location is more accurate too, because J & L tape control consistently holds tolerances of + or — .001". With the old setup, it was difficult to hold hole locations to less than .010" on layout jobs of this size.

Investigate how *production-proven* tape control units can help increase the efficiency of *your* operation. Write to Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont for folder 5902, "Tape Control Positioning".

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

JONES & LAMSON "AUTOMATION"

the man who needs a new machine tool is already paying for it



New numerically-controlled turret lathe shatters idle time . . . is ideal for short runs

At the last Machine Tool Exposition, five years ago, Jones & Lamson exhibited an automatic tape-controlled turret lathe. It created a sensation and attracted thousands of fascinated spectators. Many of them wanted to buy. But the machine wasn't for sale. Why? Because there were still "bugs" in it to be ironed out, and our reputation is too valuable to risk on an "almost" product.

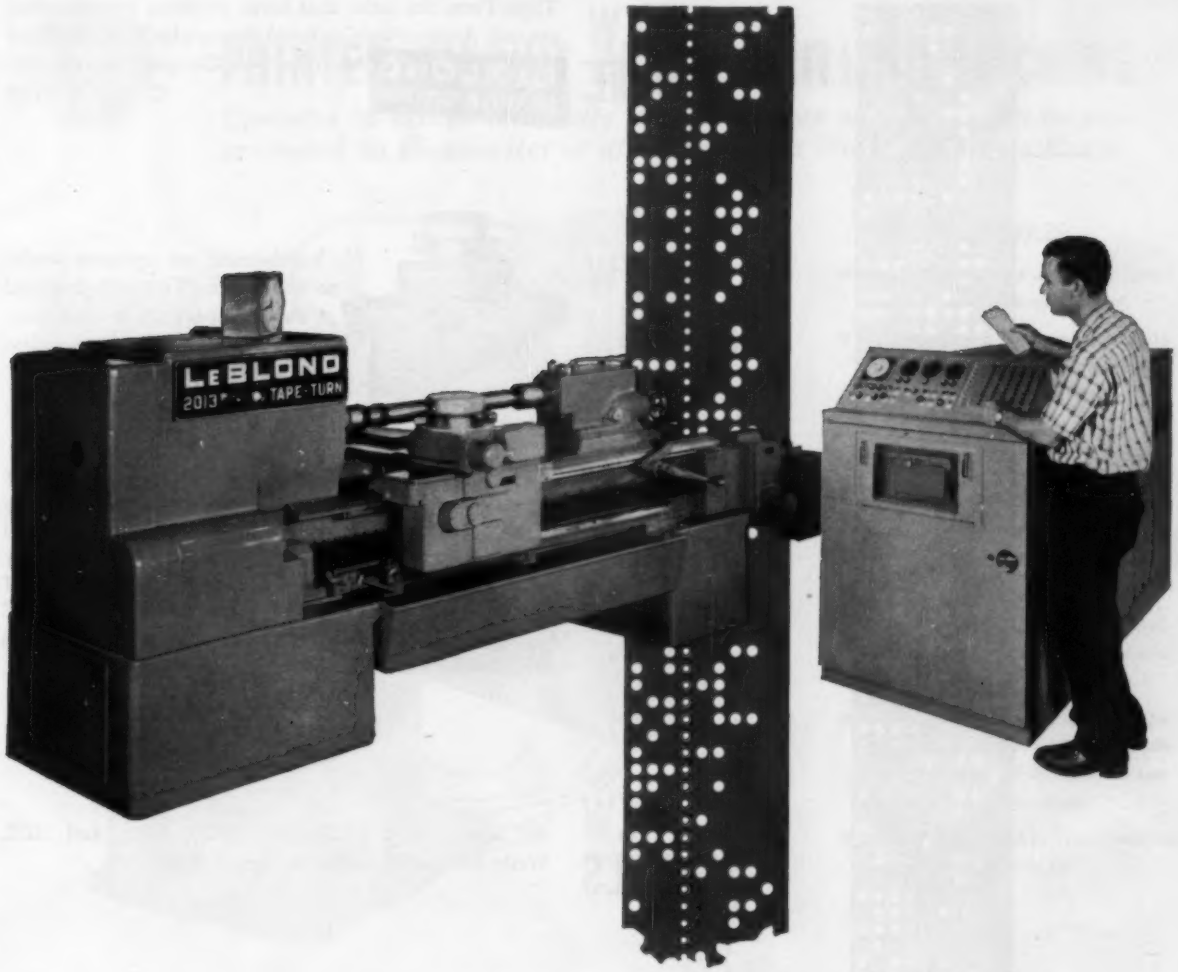
In the five years since, J & L still kept this lathe off the market, pending its complete development and proving-out. Now, it is ready to be shown, ready to be sold, ready to help you attain new production efficiency.

The new J & L numerically-controlled turret lathe is a complete redesign job. The sound features of the early prototype have been retained, and all question marks have been eliminated. In every way, this is a real beauty!

It's designed especially for short run production and top economy. It has the capacity of a No. 5 machine, 2½ x 24 in., and has three turrets (one hexagon and two square) which accept up to 14 preset tools. A set of tools plus the tape can be "packaged", ready for set-up when needed.

This lathe can be set up as either a bar machine or a chucker, in 10 to 15 min. It positions within .001″, repeats to .0005″. Drive motor is 30 HP, with spindle speeds of 40 to 2000 rpm in 24 steps. Feed rates for carriage and saddle are .750″ to 30.0″ per minute in 16 steps, plus fast motion. Cross-slide operates at one-half these rates. Tape input information may be adjusted for extended tool life and size control by manual dials on the control panel. Productivity is increased 25 to 30% over standard cycle time. Even the automatic bar feed is programmed from the tape. See it at Chicago, or write for advance information now. Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



TURN WITH TAPE

Do it with TAPE TURN, the lathe that turns contours by numerical control; and tapers, sharp angles, radii, facing cuts and plunge cuts besides, not to mention heavy duty straight turning. No need for handwheels and levers. This lathe takes orders remotely from standard 1" 8-channel punched tape or a convenient pushbutton keyboard.

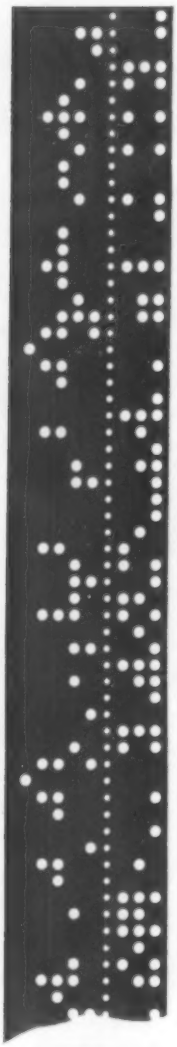
Tape-Turn puts engineering specifications at the cutting edge. Production Control can maintain control. Command by General Electric's new Mark Century numerical control. Full zero offset. Manual overrides at the console.

Turn contoured parts like this with tape and cut costs up to 75 per cent over tracer turning. Full range of spindle speeds and horsepower, all the beef you need for heavy production turning with LeBlond Tape-Turn models in several sizes. Write for documented savings with Tape-Turn, or ask your LeBlond representative for the Tape-Turn bulletin.

LEBLOND of Cincinnati

SEE SPECIFICATIONS ON BACK

THE R. K. LeBLOND MACHINE TOOL CO. *World's Largest Builder of a Complete Line of Lathes* MADISON AT EDWARDS ROADS, CINCINNATI 8, OHIO

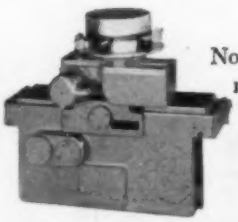


NEW NAME

Tape-Turn, the lathe that turns anything by numerical control. Another turning breakthrough by R. K. LeBlond Machine Tool Company, Cincinnati.

LeBLOND 2013 TAPE-TURN

NEW FREEDOM



No handwheels, no operator strain, no lost motion. Talk with LeBlond about Tape-Turn to modernize your shop today.

NEW CONCEPT

Remote lathe control by punched tape or by pushbuttons. New General Electric Mark Century control directs turning of compound curves to 10" radius as well as straight cuts and slopes at any angle.

NEW MODELS

All heavy duty. 2013, 2516, 3220, 4025, and 5032. Write for specifications on larger sizes.

SPECIFICATIONS

	2013 Heavy Duty	2516 Heavy Duty
Swing over bed and carriage w ngs	20"	25"
Swing over cross slide	13"	16"
Spindle speeds (30)	22-1000 rpm	22-1000 rpm
Center distance	54"	54"
Width across ways	18"	20"
Carriage cross slide travel	11½"	11½"
Turret	6 tools, 9 positions	6 tools, 9 positions
Length feed	.1 to 19.2 ipm	.1 to 19.2 ipm
Cross feed	.1 to 22.6 ipm	.1 to 22.6 ipm
Rapid length traverse	125 ipm	125 ipm
Rapid cross traverse	22.6 ipm	22.6 ipm
Motor hp	20 hp	20 hp
Motor speeds	650 to 2600 rpm	650 to 2600 rpm
Shipping weight	8800 lb.	9300 lb.
Floor space	174" x 62"	174" x 62"
Control	General Electric Mark Century	

LeBLOND of Cincinnati

TAPE TURN

THE R. K. LeBLOND MACHINE TOOL CO.

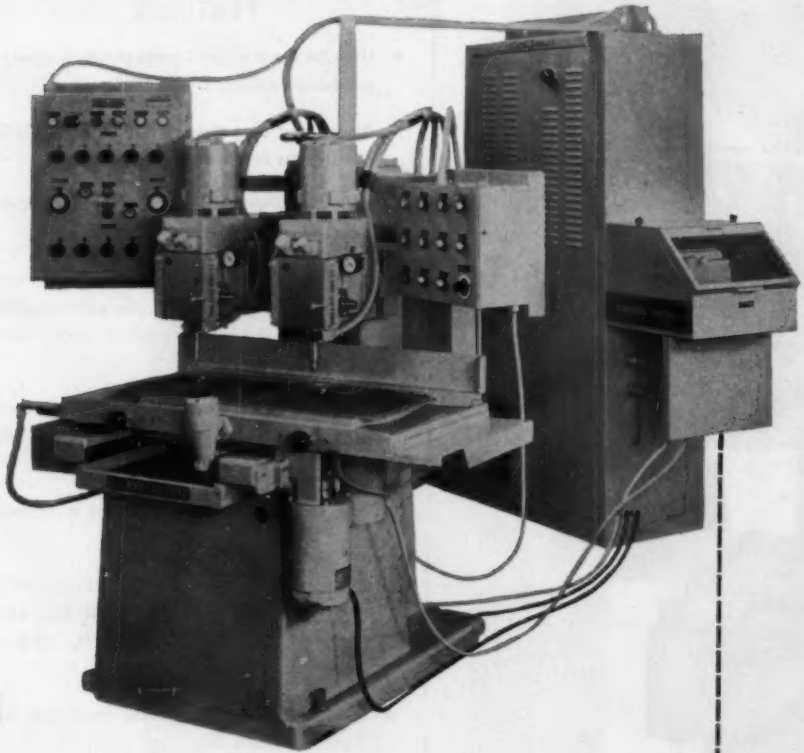
World's Largest Builder of a Complete Line of Lathes

MADISON AT EDWARDS RDS.
CINCINNATI 8, OHIO

LELAND GIFFORD

PRINTED CIRCUIT BOARD DRILLING MACHINE

Operates in excess of 50 hits per spindle per minute — May be programmed by Flexowriter or direct from Art Work or Sample Board.



FEATURES

- Programmed by Flexowriter or direct from art work or sample board.
- Table position and spindle cycle actuated by G. E. Mark II Numerical Control with fast tape reader.
- Operates in excess of 50 hits per spindle per minute.
- Drills single boards or stacks.
- Up to four adjustably mounted, self-contained, hydraulic feed drilling units can be used.
- Table traversed hydraulically on ball-bearing mounted and guided round ways.
- High speed positioning by self-contained, closed loop, hydraulic circuits and reversible G. E. Thy-Mo-Trol controlled motor driven pump.
- Nation-wide control service available from General Electric Co.

Here is a practical, economical solution to the problems of fast, accurate production of electronic printed circuit boards. Combines the best features of the proven Leland-Gifford HOLE LOCATOR and the universally accepted modified G. E. Mark II numerical positioning control.

Hole patterns can be programmed by Flexowriter or directly from art work or sample board. Table can also be positioned numerically with control dials.

Up to four self-contained hydraulic feed drilling units can be employed, adjustably mounted on cross rail, to drill in excess of 50 hits per minute per spindle.

Write for detailed information and proposal — or ask to have an experienced sales engineer call.

SPECIFICATIONS*

Positioning accuracy..... ±.001" non-accumulative
Repeatability.....±.0005"
Table size.....to suit requirements
Table travel.....Standard 11" x 15"
Optional 19" x 15"
Overhang.....14", Optional up to 22"
Spindle nose to table.....Maximum 10"
Minimum 0
Available stroke.....up to 4⅜"
Feed rate.....infinitely adjustable
Geared spindle speeds.....
500 Minimum to 7500 Maximum
or 1000 Minimum to 15,000 Maximum
Floor space required..Machine 60" x 50"
Control cabinet 94" x 47"

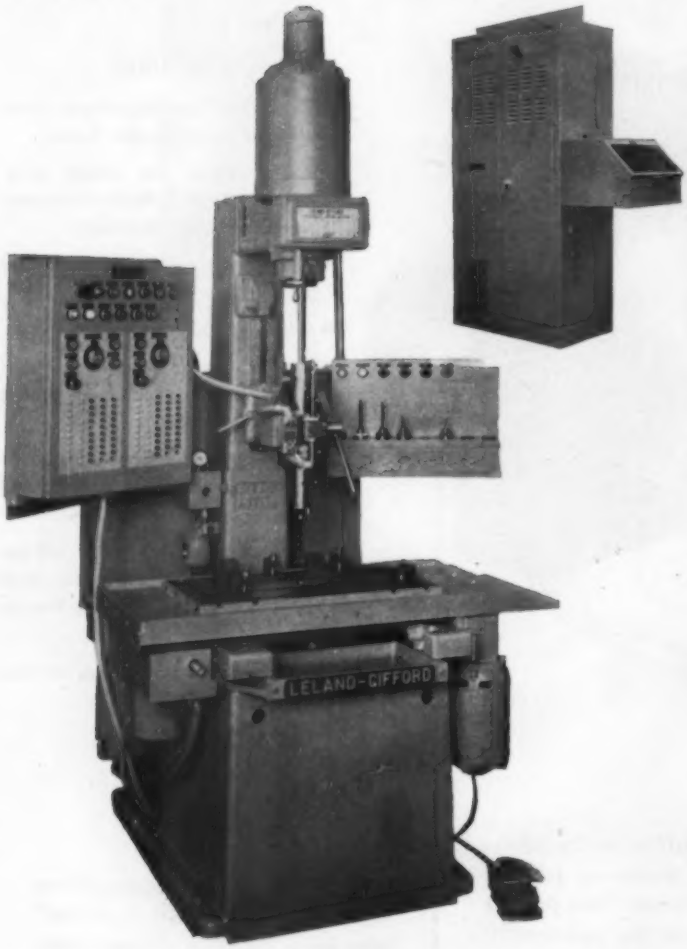
**Subject to change. Dimensions are approximate.*

LELAND-GIFFORD
WORCESTER 1, MASSACHUSETTS

LELAND ♥ GIFFORD

TAPE CONTROLLED HOLE LOCATOR

For General Purpose or Production Drilling



This sensibly simplified, sophisticated layout drilling machine combines the best features of the proven Leland-Gifford HOLE LOCATOR and the universally accepted G. E. Mark II numerical positioning control.

For single part operation, simply punch the keyboard or dial coordinates on the console. For repetitive work, use standard eight channel punched tape. Program can include automatic reversal for tapping and instant stops for tool and speed changes as indicated by flash tool change lights.

Rugged table has precision machined locating blocks, tee slots and locating keyways which extend the work capacity beyond the table traverse.

Write for detailed information and proposal or ask to have an experienced sales engineer call.

FEATURES

- Uses standard eight channel punched tape for production drilling.
- Single part operation by keyboard or dialing coordinates on console.
- Table traversed hydraulically on ball-bearing mounted and guided round ways.
- High speed positioning by self-contained, closed loop, hydraulic circuits and reversible G. E. Thy-Mo-Trol controlled motor driven pump.
- Highly accurate, sensitive precision ball-bearing spindle incorporates a zero float, quick change chuck.
- Six station turret depth stop plus 5" traverse hand feed.
- Eight spindle speeds of 150/225/300/450/-600/900/1200/1800 or 150/300/450/-600/900/1200/1800/3600 RPM, using reversing motor and back gears.
- Nation-wide control service available from General Electric Co.

SPECIFICATIONS*

Table positioning speed	200" per minute
Positioning accuracy	±.001" non-accumulative
Repeatability	±.0005"
Table size	W.S. 28" x 14"
Table travel	11" front to back x 15" left to right
Spindle overhang	13"
Spindle nose to table	17" Maximum 3" Minimum
Capacity in cast iron	7/8"
Built-in coolant system	
Floor space	Machine 60" x 50" Control cabinet 62" x 47"

Subject to change. Dimensions are approximate.

LELAND-GIFFORD

WORCESTER 1, MASSACHUSETTS

non-electronic
low cost

HYDRA-POINT

numerical control simplified

The Moog Hydra-Point is a point-to-point numerical control system which achieves highly accurate table positions by a simple hydraulic device which does not involve the use of electronics. Proven fluid power design techniques result in reliable numerical control at reduced cost and maintenance. The standard Moog system includes tape-reader, hydraulic power supply, control console and table positioning actuators.

MOOG HP
INDUSTRIAL DIVISION

THE MOOG **HYDRA-POINT**

NON-ELECTRONIC

Table positioning is accomplished entirely through the use of pneumatic and hydraulic components with no dependence upon electronic circuitry.

SIMPLICITY

Straight forward design utilizing familiar and proven principles allows in-plant personnel to perform complete maintenance.

LOW COST

Reduced investment and maintenance costs allow the application of these systems to any small or medium sized metal working plant.

ACCURACY

Accuracies of less than 0.0005 inch are an intrinsic characteristic of the fluid measuring and positioning member.

MAINTAINED ACCURACY

Built-in hydraulic gauging points, eliminating lead screws, assure continued accuracy.

HP

SYSTEM COMPATABILITY

Input information is stored in binary coded decimal form on one inch, 8-channel punched tape.

ACTUATION UNITS	
Accuracy, Absolute	± 0.0005 inch.
Accuracy, Repeatable	± 0.0003 inch.
Positioning speed	200 inches per minute.
No. of Axes	1 or 2.
Minimum increment	0.001 inch.
INPUT SECTION	
Tape Reader	Pneumatic block reader (20 lines per block).
Code	Binary coded decimal, fixed sequential form.
Operational modes	Automatic Semi-automatic Manual-dial.

A pneumatic block tape-reader is used to read coordinate and auxiliary instructions from a standard 1-inch, 8-channel punched tape. Signal air pressures from the reader are amplified hydraulically and used to position two sets of decoder switch plates on each of two actuators. One set of plates select one of a number of holes spaced at 0.1 inch intervals along the axis of the actuators. The selected hole acts as a valve port in a hydraulic 3-way valve controlled servomechanism. The other set of plates select one of a hundred holes equally distributed along the circumference of a rotary actuator. The rotary actuator establishes the angular position of the helical valve land of the hydraulic servo, thereby achieving a minimum position increment of 0.001 inch.

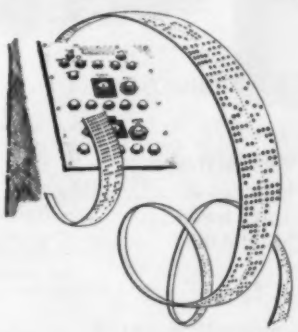
MOOG SERVOCONTROLS, INC. INDUSTRIAL DIVISION EAST AURORA, N. Y.

LUCAS
PRECISION

The most versatile boring, drilling and milling machine offers the best combination of controls for all machine motions

Lucas plus N.P.C. presents many advantages that contribute to more production, greater efficiency and a higher degree of accuracy:

- Reduce direct and indirect labor
- Reduce inventory
- Reduce floor space
- Reduce tool costs



- Eliminate jigs and fixtures
- Eliminate scrap
- Eliminate human error
- Control production

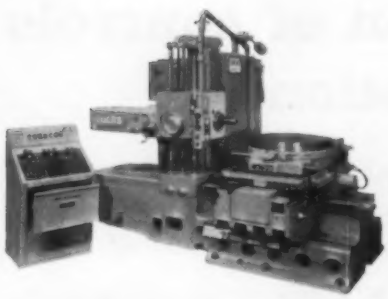
and improve quality while simplifying and improving engineering methods

The only way to get a maximum return on your Numerical Control Investment is to apply it to the best possible machine for the job. Lucas has led the table-type and floor-type boring, drilling and milling machine field since 1901. When it comes to point-to-point positioning, Lucas has installed more numerically controlled horizontal, table-type machines than any other manufacturer. This wealth of experience enables your Lucas sales engineer to recommend the best possible combination of Lucas machines and numerical controls for your applications. Let us analyze your manufacturing problems and prepare time studies.

The Lucas, through the tape reading system selects travel of spindle, head, table, and/or saddle, unclamps units when in motion and clamps when the directed position is reached. Other functions from the tape include tapping cycle; changing of feeds and speeds; spindle power tool lock clamps or ejects the tools; spindle dwell at end of the programmed travel; coolant "on" or "off"; orientation of spindle stop at a desired point of rotation, which is necessary when using a tool magazine. Simultaneous motion of unit travels and dual storage of information eliminates lost time from operation to operation.

Your choice of a full range of controls on LUCAS HORIZONTAL BORING, DRILLING AND MILLING MACHINES

Controls and applications discussed here are typical of those available for the entire Lucas line, which ranges from 2¾" to 7" diameter spindle models. All controls are available separately or in any combination.



MODEL 41B48-S

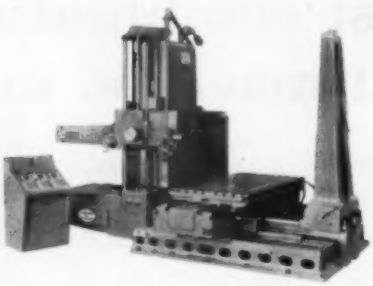
Vertical travel:..... 36"
Main table:..... 42" x 50"
Table travel:..... 48"
Saddle feed:..... 29"
Rotary table:..... 36" dia.

Three methods of control combined on one machine suits this Lucas for any size run.

Multiple Control Pendant: selects 26 speeds from 13 RPM to 1500 RPM; 42 feeds from .0001 to .698"; positions head, table and saddle; selects power tool ejector; also allows for pre-select changes of feeds and speeds.

Punch Key System: program controls head, table, saddle and rotary table, speeds and feeds from three panel console.

Numerical Control with Tape Reader: completely tape-controls all motions of head, table, saddle, rotary table, plus speeds and feeds.



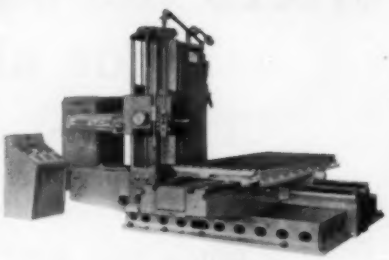
MODEL 542B-84

Vertical travel:..... 84"
Main table:..... 48" x 84"
Table travel:..... 72"
Saddle feed:..... 45"

Two methods of control are combined.

Multiple Control Pendant: selects 26 speeds from 9 RPM to 1200 RPM; 42 feeds from .0001 to 1.038"; positions head, table and saddle.

Punch Key System: program controls head, table and saddle from three panel console.



MODEL 542B-120

This machine shown with back rest omitted offers the same controls and controlled motions of the head, table, saddle feeds and speeds as Model 542B-84.

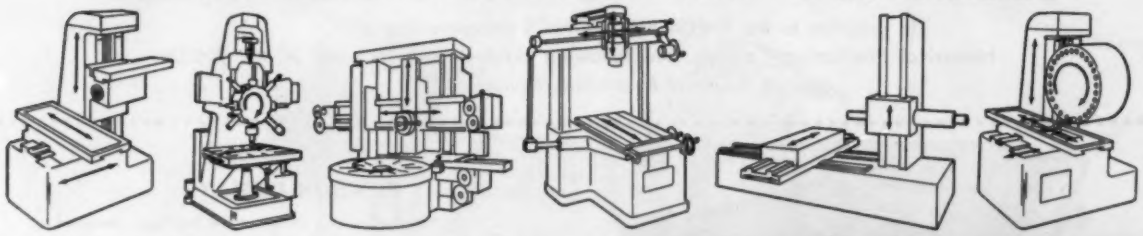
LUCAS
PRECISION

For complete literature or a dramatic demonstration of Lucas plus N.P.C. in action, see your Lucas dealer, your Lucas sales engineer or write directly to Lucas Machine Division, the New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio.

Put your Precision on a **LUCAS**

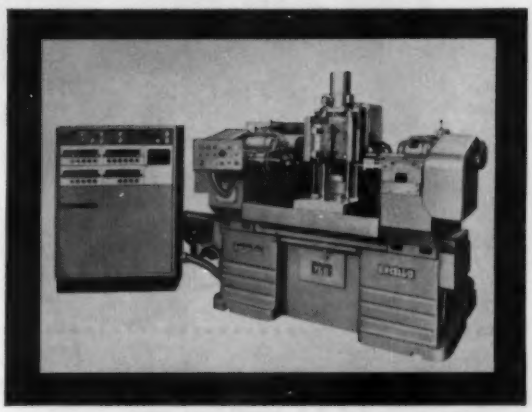
Rheem Electronics

NUMERICAL POSITIONING CONTROLS



New Features!

Economy
Flexibility
Reliability
Quality
Accuracy



RHEEM Numerical Control pictured with Excello Model 758 Numero-trol precision boring machine.

This is the advanced automation system that operated so successfully and reliably during the 1960 Machine Tool Exposition in Chicago!

The system represents major advances in the industry in degree of automation attained. For example, it is . . . *the first system to achieve automatic control of bore diameter while the spindle rotates* and *the first system to distribute tape information electronically, eliminating less reliable stepping and crossbar switches.*

Among the other advantages provided by RHEEM Numerical Positioning Controls are:

MODULAR CONSTRUCTION BY AXES
DIFFERENT RESOLUTIONS AVAILABLE
HIGH POSITIONING SPEEDS
FEED RATE CONTROL AVAILABLE
LARGE TRAVEL DISTANCES
***DECIMAL DISPLAY OF TAPE INFORMATION**
***AUTOMATIC, SEMI-AUTOMATIC, AND MANUAL OPERATION MODES**
VIRTUALLY UNLIMITED AUXILIARY FUNCTIONS

An outstanding example of the versatility provided by RHEEM Numerical Controls is illustrated by the low cost addition of a third axis control to many two-axis systems, e.g. turret drills, drill presses, radial drills, vertical boring machines, etc., all with two-axis positioning tables.

Manual input of dimensional information and decimal display available at no extra cost.

General Control

SPECIFICATIONS

Number of Axes Controllable	5 axes; more by special provision
Travel	Virtually unlimited in all axes
Control Accuracy	±0.0005" for 0.001" Resolution ±0.0001" for 0.0001" Resolution *(all axes if desired)*
Positioning Speed	Limited by resolution only
Tape	1-in. wide, 8-channel Al-Mylar laminate
Tape Reading Speed	100 lines/second
Auxiliary Functions	Virtually unlimited
Feed Rates	Large number available in any or all axes
Operation Modes	Automatic, Semi-Automatic, Manual
Voltage Requirement	117 vac, 60 cps, single phase
Cabinet Size	2 axes or time shared 3 axes, 20"x27"x54" 4 axes, 20"x42"x54"

Please write for complete information TODAY!
Our engineers will be pleased to assist you.

Rheem electronics *A division of Rheem Manufacturing Company*

5200 West 104th Street
Los Angeles 45, Calif.
SPring 6-1800

Rheem Electronics

INDUSTRIAL AUTOMATION EQUIPMENT

In addition to the RHEEM ELECTRONICS complete line of Numerical Positioning Controls, the following products are included in the RHEEM line of Industrial Automation Equipment

Rheem Position Display

POSITION DISPLAY

The display unit shown at left has been designed to meet the requirements of operator controlled machines including retrofit on existing machines. The unit provides a continuous display of machine position in decimal form.

The Rheem Position Display is used in conjunction with a position transducer to detect machine slide displacement in increments of .001 inches. The operator may elect to have the absolute position from a zero reference point continuously displayed, or the incremental distance between two coordinate positions. This unit will allow the operator to position the machine more rapidly and with greater accuracy.

The Rheem Position Display is a compact unit occupying less than one cubic foot of space per axis.

SPECIFICATIONS

Tape.....5, 7, & 8 channel tapes, paper or aluminum Mylar types

Reading Speed...100 characters per second — Stop on character. Higher speed models will be announced later.

Outputs....8 Information and 1 Timing signal, all appearing simultaneously.

No Hole $< 50\ \mu$ amps. 0 Volts

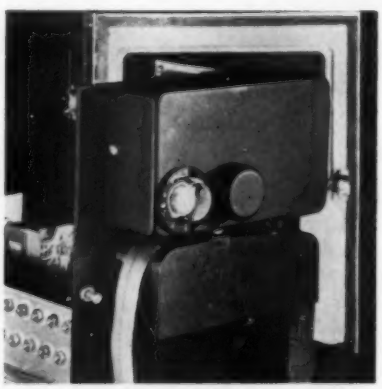
Hole 5 ma. —15 Volts

Voltage Requirement.....117 vac 60 cps

PHOTOCELL READER

RELIABLE
LOW COST
TRANSISTORIZED

The Rheem Photocell Reader is designed to meet the error-free, reliable, rugged requirements of general purpose punched tape reading and machine tool controls. The unit is completely transistorized and uses silicon solar cells as sensing elements.



Reader packaged for Rheem Numerical Positioning Controls. Other configurations available, desk-top or panel mount.

Rheem Position Transducer

POSITION TRANSDUCER

Shaft to Digital Converter

LOW TORQUE LOAD
PRECISION CONSTRUCTION
HIGHLY RELIABLE SENSING ELEMENTS
NO CODED DISCS
NO CONTACT PICKUPS

In this unique device, the sensing elements are two magnetic heads detecting the rotation of the shaft by an impedance change in the head. The head outputs are phased so that external electronics can determine rotation direction and magnitude. The output signals can also be used in a self checking circuit. A third sensing head is included to detect each complete revolution of the transducer shaft. This can be used for accurate zero position when used for linear motion detection.

SPECIFICATIONS

Head Impedance....High — 100 ohms 0.15 mh. @ 300 kc
Low — 80 ohms 0.12 mh. @ 300 kc

Typical Bridge Input.....300 kc — 28 volts rms

Typical Bridge Output...Low — 0 volts
High — 5 volts p-p

Resolution....500 increments/revolution

Weight.....1.5 lbs. approx.

Size.....2.50 in. diameter
3.00 in. length (body)
4.00 in. length (overall)

Shaft Length.....9/16 in.

Shaft Dia.....0.250 in.

Inertia.....0.3 oz.-in.^{2}

NOTE: Transistor or Vacuum Tube drive and detector units are also available.

Please write for complete information TODAY!
Our engineers will be pleased to assist you.

Rheem electronics *A division of Rheem Manufacturing Company*

5200 West 104th Street
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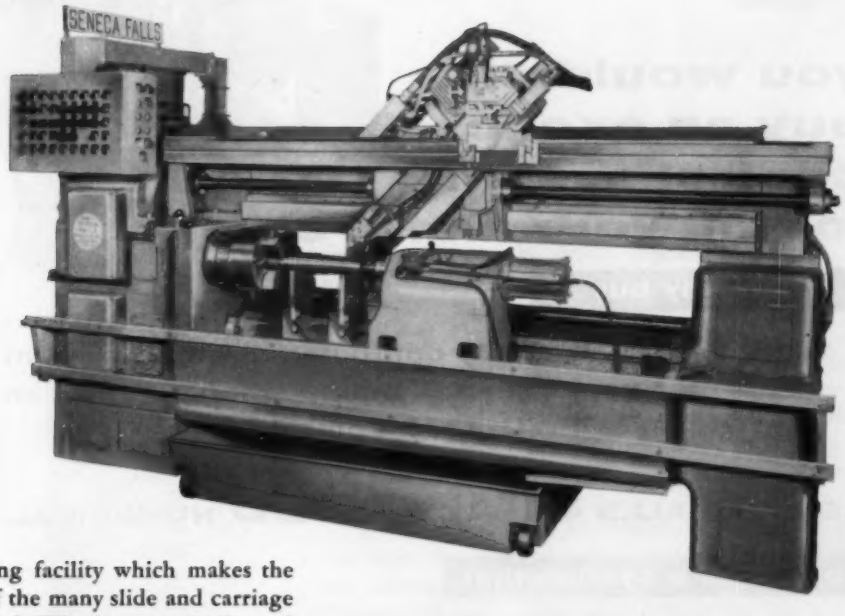
SENECA FALLS SIMPLIFIED NUMERICAL CONTROL

on a Model Q Tracer Lathe



Offers a programming facility which makes the most effective use of the many slide and carriage configurations offered. Whether a multiple tool carriage is used in combination with a single tracer for maximum production or a single tracer employing multiple pass operation for short and medium runs is selected, either method is programmed to assimilate magnitude of carriage and slide movement, sequence, feed, speed and indexing tool block position.

Record sheets of the program are easily stored for future re-runs; thus set-ups are made in a few minutes with complete assurance that the job will run exactly as originally set.

The Seneca Falls Control System makes operation of this lathe completely automatic and enables set-ups to be made most efficiently.

SENECA FALLS SIMPLIFIED NUMERICAL CONTROL

is also offered for control of speed . . . position . . . instruments . . . manufacturing processes . . . synchronized drives . . . etc., etc.

In addition to complete systems we can supply sensing devices . . . control components . . . tape controls . . . power drives . . . any tables, carriages or movable structures required

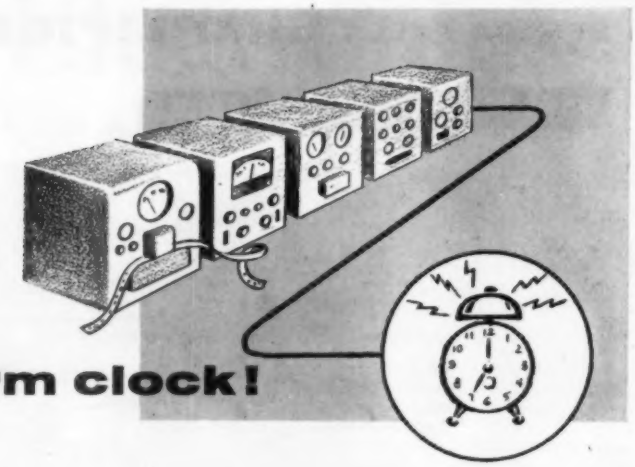
When designing complete systems we assume full responsibility for both control system and machine, guaranteeing final performance to your specifications.

Write telling us all about your control problem and the application . . . for machine, automated production or assembly line, process, etc., etc.

SENECA FALLS MACHINE
PIONEERS IN AUTOMATION

SENECA FALLS MACHINE CO., SENECA FALLS, N.Y.

SENECA FALLS MACHINE
PIONEERS IN AUTOMATION



you wouldn't buy an exotic control system to ring your alarm clock!

then why buy

a costly computer-directed system for your automatic lathe when all you can use is TWO-AXIS control?

SENECA FALLS SIMPLIFIED NUMERICAL CONTROL

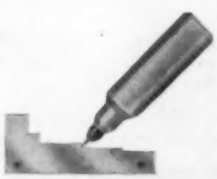
provides a system that

- offers a truly economical solution to the problem of turning a complex shape from bars or rough forgings.
- offers step-cut capability for removing large quantities of material in preparation for efficient tracing procedure.
- permits immediate "on-the-floor" program revisions when engineering changes, material specifications, or tool limitations dictate.
- uses direct decimal read-out and storage facility as a function of the manual input.
- utilizes only the simplest electrical components which are easily removed for service.
- eliminates the need for computer-directed, continuous pass tape systems.
- has proven its performance and dependability in actual field use.
- excludes many limitations of ordinary tracer turning.

SENECA FALLS SIMPLIFIED NUMERICAL CONTROL

operates this way

- direct reading, decimal dials on the programming panel are manually set for diameter, start, and end of cut as dictated by the part geometry and necessary stock removal. Provision can be made for up to ten passes.
- Final geometry and size of the part are precisely controlled by a single template and a closed loop servo system. Start position and end of cut are established by input dials on the programming panel.



FOUR REASONS WHY YOU SHOULD SPECIFY SPERRY CONTROLS...

SIMPLICITY

There are fewer components in a Sperry Control, thanks to the pneumatic block reader that does away with complex memories or shift registers. Fewer components mean higher reliability, and easier maintenance.

ACCURACY

Independent linear measuring scales provide extremely high accuracy unaffected by age or wear. The initial accuracy built into the machine remains constant throughout its life.

RELIABILITY

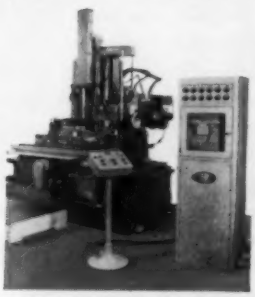
Sperry Controls contain almost 33% less components than conventional designs and by this fact alone are considerably more reliable. Machines equipped with Sperry Controls do not use vulnerable ball bearing leadscrews, thus simplifying machine maintenance too.

SPEED

The Sperry block reader can read one two co-ordinate position and auxiliary commands in 1/10 of a second. This fact combined with the high performance of hydraulic actuators, provides exceptionally high positioning speeds. Traverse speeds of 700"-1000" per minute are being achieved on certain machines.

SPERRY SPERRY GYROSCOPE COMPANY OF CANADA, LTD.

The Owners of these Fine Machine Tools Specified SPERRY Controls



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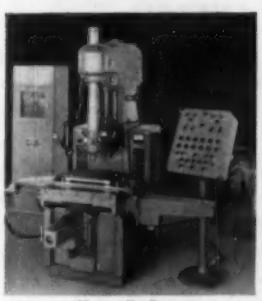
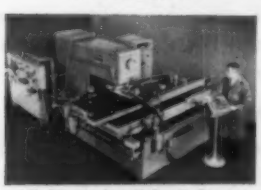


Moore Jig Borers



Wiedematic Turret Punch Presses

W. B. Knight Jig Borers

American Tool Works Co. Boring & Drilling Machines

Bullard Spacer Tables (Retrofit Kit)

Burgmaster Turret Drills

TECHNICAL DATA SHEET
SPERRY NUMERICAL MACHINE TOOL CONTROL

PROGRAMMING

The Sperry Control uses E.I.A. standard 1" 8 track paper or mylar tape and E.I.A. standard coding. Programming is extremely simple using any standard tape punching equipment.

TAPE READER

The exclusive Sperry block reader uses low pressure air flow to read punched tape. The air pressure also keeps the reading head and tape clean, thus eliminating reading errors. This type of reader can process information at very high speeds.

NO MEMORY STORAGE

There is no memory storage in the Sperry Control. The memory (or shift register) is eliminated by the block reading technique employed.

MANUAL CONTROL

Manual input switches are standard equipment with all Sperry Controls. These are extremely useful in cases where tape preparation may be undesirable due to the simplicity or shortness of the run.

THE MEASURING SYSTEM

The Sperry Control uses very precise electronic measuring scales (transducers). They are made of a special glass/mica compound which has a coefficient of expansion similar to steel and temperature changes do not therefore introduce measurement errors. These scales are mounted parallel to machine motion and do not rely on the accuracy of leadscrews, racks and pinions or other mechanical devices.

THE DRIVE SYSTEM

Sperry has developed a special electro hydraulic servo valve for machine tool application. This valve is of very simple design, without linkages, springs or "dither impulse". The valve accurately controls hydraulic motors or cylinders. Most machines with Sperry systems offer high speed cylinder drives which eliminate expensive and hard to maintain ball screws. Clamping the machine member can often be avoided as the Sperry valve will hold position with considerable force and accuracy.

THE CABINET

The Sperry Control is housed in a NEMA cabinet which is fully sealed and gasketted to keep out chips and dirt. The Control pedestal is also sealed and designed for operator convenience.

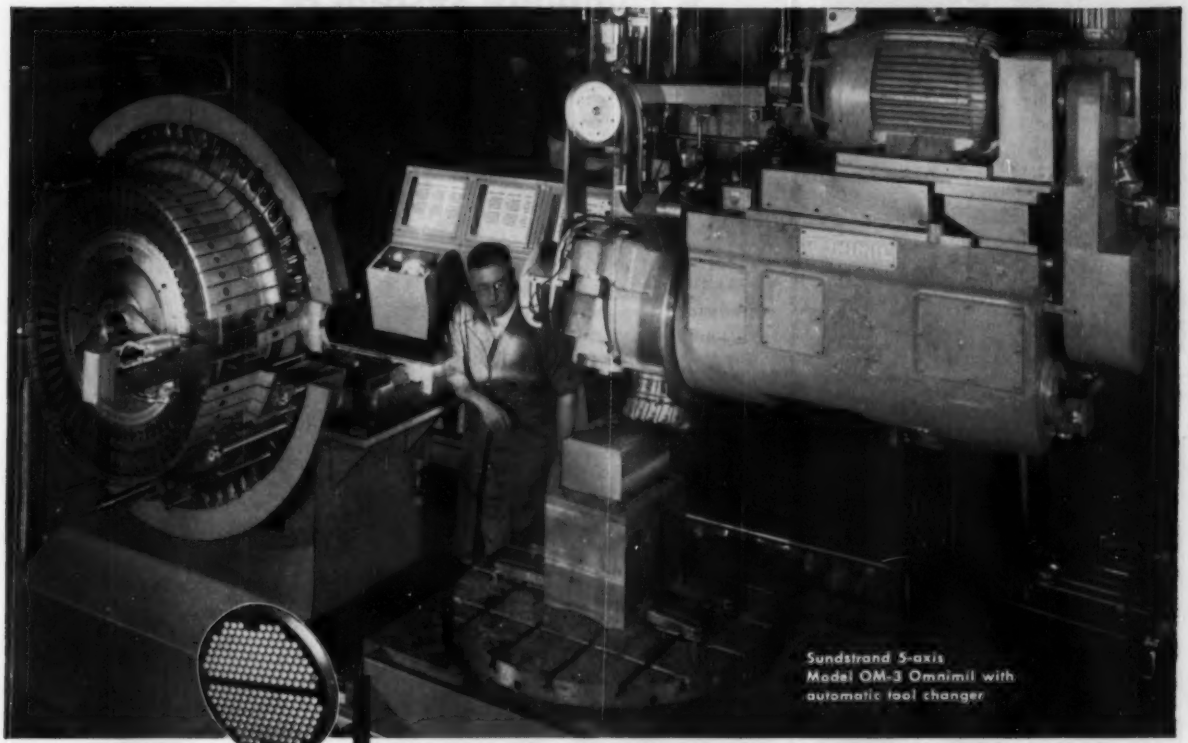
Further information can be had from machine tool builders and dealers—or write us direct for illustrated brochure. A powerful and dramatic 15-minute sound movie on the Sperry Numerical Control is also available—ask to see it.

SPERRY

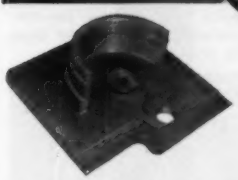
SPERRY GYROSCOPE COMPANY OF CANADA, LTD.

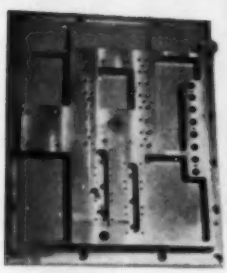
P.O. Box 710 **Montreal, Que.**

MANUFACTURED IN U.S.A. BY WHEELER ELECTRONICS CORP. SUBSIDIARY OF SPERRY RAND CORPORATION.



Sundstrand 5-axis
Model OM-3 Omnimil with
automatic tool changer





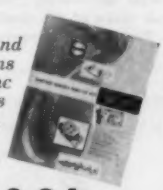
Sundstrand
"Engineered Production" concept applied to numerical control

New Sundstrand machines with numerical control have been developed to meet the Sundstrand "Engineered Production" concept — which starts with the piecepart and your production requirements and then provides the machine that makes the best sense economically.

This approach takes into consideration the size of part, the operations to be performed, the number of setups involved, parts handling between machines, and the like. It has resulted in the development of a complete system of machines as clearly illustrated on the next page.

For complete information, ask for a Sundstrand "Engineered Production" analysis of your operations and send for new Bulletin No. 121 covering Sundstrand numerically controlled machine tools.

For details and specifications on the machines illustrated, ask for Bulletin 121.



SUNDSTRAND

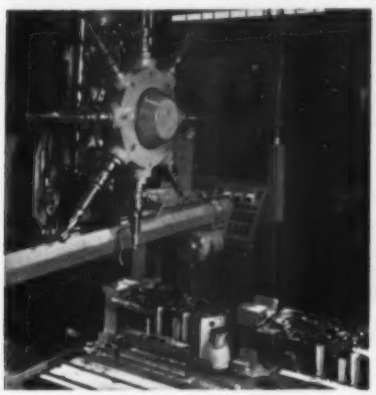
SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION

A complete system of numerically controlled machines to best meet your requirements

Some of the Sundstrand machines illustrated here are completely new types developed to provide the advantages of numerical control for a broad range of work requirements. Others are familiar Sundstrand machines with necessary design modifications to take the fullest advantage of numerical control. One of them is ready to fit your production problem — to replace one or more machines now performing the same operation, or to combine several operations now performed on different machines.

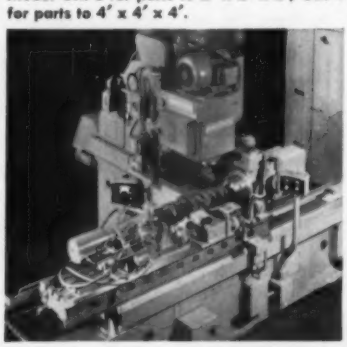
Simple vertical head machine incorporating Sundstrand two-axis 20" x 30" Jigmatic table. Table also available separately.



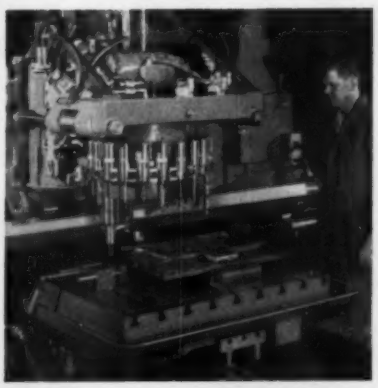
Three-axis machine with turret head and 40" x 60" table handles workpieces too large for the Jigmatic table.

Three-axis horizontal-spindle machine for milling, boring, drilling, reaming, and tapping. Available with rotary index fixture to present all four sides of the workpiece to the cutting tools. Positioning or contouring control.

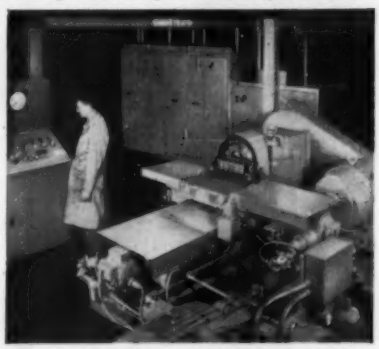
Five-axis Omnimil mills, drills, bores, reams, taps all exposed faces of the workpiece at any angle. Positioning or contouring control. Model OM-3 for parts to 2' x 2' x 2', OM-4 for parts to 4' x 4' x 4'.



Sundstrand "Engineered Production" machine, built primarily of standard components, to mill locating spots on six different crankshafts.

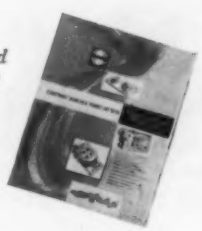


Three-axis machine with 40" x 60" table and 20-position automatic tool changer handles drilling, boring, reaming, tapping, and light milling. Positioning or contouring control.



Sundstrand lathes with multiple tooling for straight and contour turning, controls speeds, feeds, order of presentation and cutting path of each tool.

For details and specifications on the machines illustrated, ask for Bulletin 121.

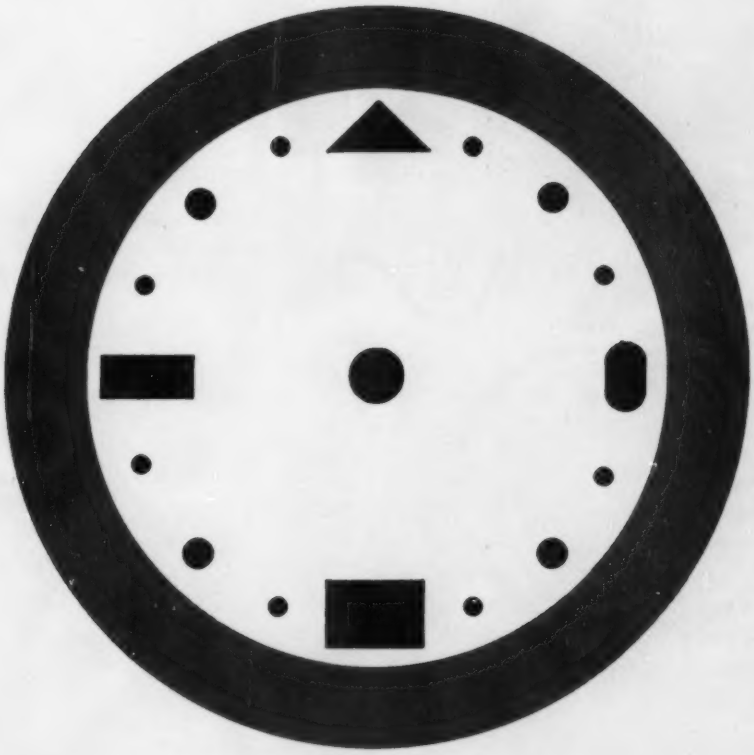


SUNDSTRAND

SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION

WIEDEMATIC



THE WORLD'S FASTEST TAPE-CONTROLLED MACHINE TOOL

POSITION at 500 in. per minute and PUNCH to 60 holes per minute — completely tape-controlled
TOOLS IN TURRETS positioned automatically
ACCURATE hole locations to ± .004-in.
CAPACITY for any sheet metal or plate punching need
SPEED to produce medium production lots economically
FLEXIBILITY to produce very small lots profitably
EASY TO PROGRAM . . . requires only X-Y coordinates and turret station number
SAVINGS in every phase of plant operations from design to assembly

Add up the savings you can expect on more than 100 costly factors that are simplified or eliminated with a WIEDEMATIC Turret Punch Press, as listed in the booklet "Behind the Scene Savings of the WIEDEMATIC." Send for your copy today.

WIEDEMANN MACHINE COMPANY
DEPT. AM-11 • GULPH ROAD • KING OF PRUSSIA, PA.

WIEDEMANN

A-15 WIEDEMATIC

WIEDEMATIC TURRET PUNCH PRESS
Capacities from 15 to 150 tons

All of these turret punch presses are available with proven numerical positioning control systems using standard one-inch, eight channel tape.

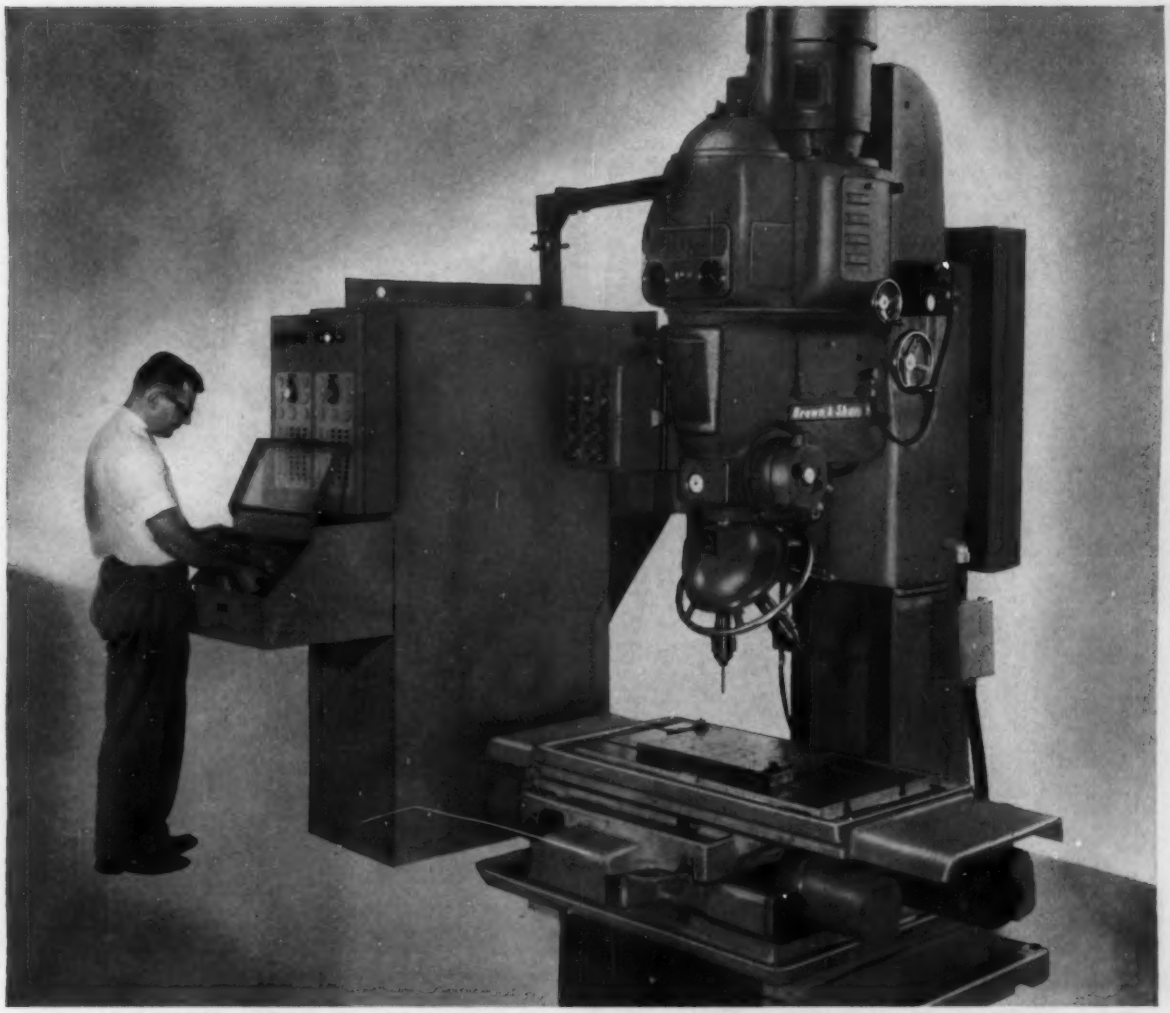
SPECIFICATIONS

	A-15	A-30	A-50	A-100	A-150
1. Press Capacity	15 Tons	30 Tons	50 Tons	100 Tons	150 Tons
2. Throat Depth	32"	38" and 50"	50"	63"	75"
3. Crankshaft Strokes per Min.	200	200	180	120	85
4. Stroke	7/8"	1-1/4"	1-1/4"	2"	2"
5. Maximum Material Thickness	3/16"	1/4"	1/4"	3/8"	1/2"
6. Maximum Hole Diameter	3-1/2"	4-1/2"	6-1/2"	8"	8"
7. Material Thickness for Maximum Hole	14 ga. (.074")	1/8"	10 ga. (.134")	1/4"	5/16"
8. Turret Outside Diameter	33"	43"	49"	55"	55"
9. Number of Turret Stations (Standard layouts available)	30	28, 30 and 32	30, 32 and 36	26, 30 and 32	26, 30 and 32
10. Turret Drive	Hydraulic motor	Hydraulic motor	Hydraulic motor	Hydraulic motor	Hydraulic motor
11. Turret Maximum Speed	10 R.P.M.	10 R.P.M.	10 R.P.M.	10 R.P.M.	10 R.P.M.
12. Maximum Sheet Size	30" x 48" and 30" x 72"	36" x 60" 48" x 60" and 48" x 96"	48" x 60" and 48" x 96"	60" x 100" and 60" x 120"	72" x 120"
13. Crosswise Traversing Speed—Max	600"/Min.	600"/Min.	600"/Min.	500"/Min.	400"/Min.
14. In-Out Traversing Speed—Max	600"/Min.	600"/Min.	600"/Min.	500"/Min.	400"/Min.
15. Traversing Power	Hydraulic Piston	Hydraulic piston	Hydraulic piston	Hydraulic piston	Hydraulic piston
16. Hydraulic Pump Capacity	10 g.p.m. 1000 p.s.i.	15 g.p.m. 1000 p.s.i.	15 g.p.m. 1500 p.s.i.	20 g.p.m. 2500 p.s.i.	30 g.p.m. 2500 p.s.i.
17. Hydraulic Pump Motor	5 H.P., 1800 R.P.M.	10 H.P., 1200 R.P.M.	15 H.P., 1200 R.P.M.	25 H.P., 1200 R.P.M.	40 H.P., 1200 R.P.M.
18. Accumulator Size	10 Gal.	10 Gal.	10 Gal.	15 Gal.	15 Gal.
19. Overall Length	125"	152" (2)	165"	225"	285"
20. Overall Width	116" (1)	150" (2)	150" (3)	242" (4)	280"
21. Overall Height	70"	80"	90"	110" (18" of this below floor)	110" (18" of this below floor)
22. Estimated Weight	15,000 lbs. (1)	35,000 lbs. (2)	50,000 lbs.	75,000 lbs. (4)	100,000 lbs.
23. Estimated Production Rate	60 Hits/Min.	50 Hits/Min.	40 Hits/Min.	30 Hits/Min.	25 Hits/Min.
24. Estimated Absolute Hole Accuracy	±.004"	±.006"	±.008"	±.010"	±.012"

(1) For 30" x 48" sheet only.
(2) For 50" throat and 48" x 60" sheet only.
(3) For 48" x 60" sheet only.
(4) For 60" x 100" sheet only.

WIEDEMANN

WIEDEMANN MACHINE COMPANY
DEPT. AM-11 • GULPH ROAD • KING OF PRUSSIA, PA.



TURR-E-TAPE Turret Drilling Machine with Numerical Positioning Control — demonstrated at the CHICAGO EXPOSITION.

New TURR-E-TAPE permits up to 75 to 1 reduction in tooling costs for drilling, tapping, boring, reaming

The TURR-E-TAPE, a tape-controlled Brown & Sharpe Model B Turret Drilling Machine, automatically performs a series of drilling, tapping, and boring operations in work moved automatically to hole locations on a Brown & Sharpe Positioning Table.

Indexing, starting and stopping of tool operation, and rapid movement of work from hole center to hole center are all performed in response to programmed tape in the numerical positioning control. No complicated jigs, fixtures, or guide bushings are required. Tooling costs are virtually eliminated, and further savings are realized in skilled labor costs and nonproductive time.

The TURR-E-TAPE method provides revolutionary advantages for plants machining numerous short runs of parts, or long runs of parts used a few at a time.

For details, write: Machine Tool Division, Brown & Sharpe Manufacturing Company, Providence 1, R. I.

Turret Spindles
6 with 3 M.T. taper

Drilling and Tapping Capacity
1" (in free machining steel)

Quill Travel
9"

Spindle Speeds
Preselective, 125-2000 RPM infinitely variable

Spindle Feeds
.0025-.021" per revolution

Turret Index
Preselective tape, power, manual

Air Supply
Controls speed and feed

Coolant System
Integral base tank

Drive Motor
5 H.P. 2-speed (1800-900 RPM) 220 or 440 or 550/3/60

Positioning Table Work Surface
20" x 30"

Table Travel
15" x 20"

Head Travel
12" (Vertical)

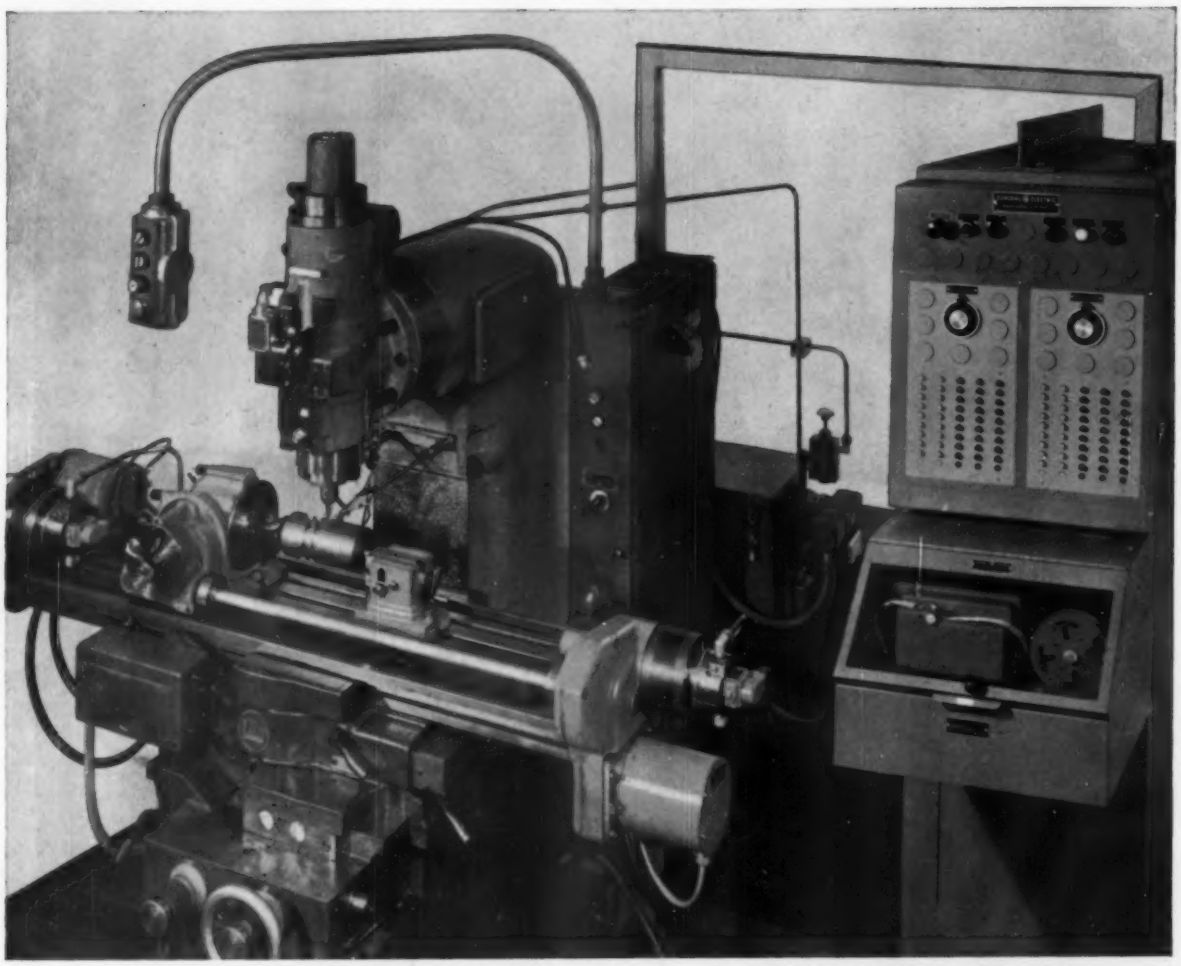
Maximum Clearance
24⅛" (Spindle to table)

Throat Depth
18¾"

Floor Space
(machine only) 67" x 72"

Net Weight
5700 lbs. (approximate)

Brown & Sharpe PRECISION CENTER



NUMERICAM Cam Milling Machine with Numerical Positioning Control — demonstrated at the CHICAGO EXPOSITION.

New Brown & Sharpe tape-controlled NUMERICAM saves up to 80% of cam layout and machining time

The NUMERICAM is a revolutionary new tape-controlled system for low-cost production of prototype or master cams. The new B&S milling machine used has hydraulic power down feed for the cutter spindle and electrically-controlled servo-drive for index centers and table. It is directed by a numerical positioning control, which can be any make specified by buyer.

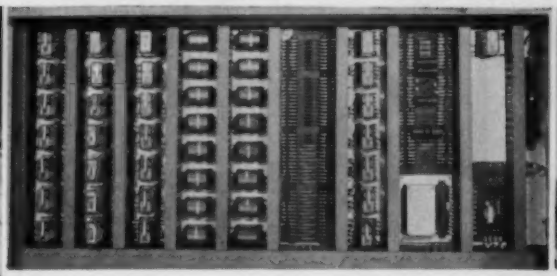
The computing and control equipment used is relatively simple, since the NUMERICAM employs a point-to-point machining system, rather than full contouring. Cam paths are machined with exceptional accuracy. Cams of average throw (6″ or less) can be held to a tolerance of ±.0002″ and hole pattern spacing to a quarter-thousandth.

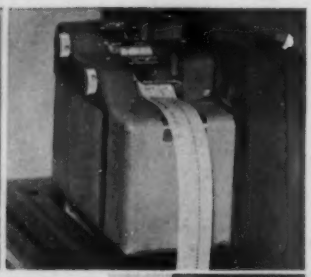
The NUMERICAM can turn out precision machined cams in one-fifth the time required by manual methods. It eliminates tedious blueprint preparation, and prevents spoilage due to human error. For details, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

Spindle drive motor 5 HP. **Spindle feed range** 3½″. **Universal index centers** 10″, with electrically-controlled servo-drive. Choice of alternative 10″ cross positioning optional. **Numerical positioning control** directs index centers to one hundred thousandth part of a circle by either dial or 8-channel tape. Directs table to one ten thousandth of an inch over a 10″ range.

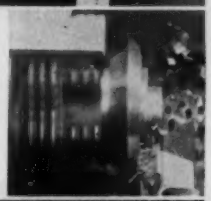
NUMERICAM mills any cam path or hole pattern in cylindrical, conical or flat surfaces; on plate cams or templates.

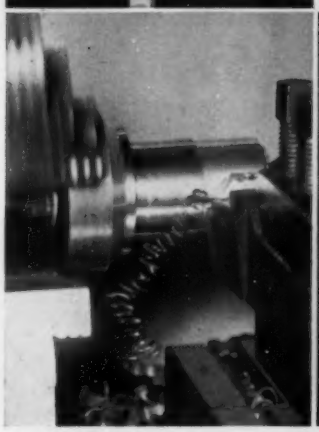
Brown & Sharpe PRECISION CENTER





The Tape-r-guide Lathe





Numerical Control with Simplicity through Incremental Tool Travel

As you have heard, there is the wonderful new world of numerical control: the world of

- profitable small-lot production
- reduced finished parts inventories
- minimum tooling requirements
- maximum machine utilization
- fast setup
- quick job-to-job change-over
- unerring mechanical control.

Now, add its capability for accurate part-to-part duplication, and you can begin to judge the depth of its influence.

If you're shopping numerical control lathes . . .

then it is to your advantage to know that you can gain all these benefits in a numerical control lathe that has a low initial cost, easy year-after-year maintenance, simplicity of operation (and understanding), and gentle consideration of your valuable plant floor space. All this is yours in the new Barber-Colman Tape-r-guide. Why? Because of this thing called *incremental tool travel.*

Incremental tool travel is a Barber-Colman innovation in numerical control . . . a different approach to the tape-controlled lathe. To understand it, it's helpful first to consider the fundamentals of lathe operation.

A lathe does its work by holding a cutting tool against a rotating workpiece, feeding the tool in a longitudinal direction with respect to the axis of the workpiece, in a transverse direction, or in some combination of the two, to produce a desired contour. In a numerical control lathe, the operator has been largely replaced by nonhuman control. How, then, are these tool movements to be managed?

A choice of possible methods

Tool movement along a given axis could be controlled by establishing a sort of electrical yardstick along which a tool could travel, reading voltage levels along the way to determine its stopping point. This frequently used system would require a second, guiding yardstick with a critical voltage at the stopping point. When the voltage reading at the tool matches the predetermined voltage level at the stopping point, an electrical null would occur, telling the tool that it had reached the mark. Overshooting or undershooting could be detected by the variation from the null, and corrections made accordingly.

Such a system might require transducers to convert tool travel into corresponding electrical voltage which could supply feedback reading for making the comparison. Tool

CIRCLE 360 READER SERVICE CARD

The Barber-Colman system selects precise travel movements
thereby eliminating feedback reading equipment

(Continued from preceding page)

travel would have to be programed from a "zero point," the beginning of the electrical yardstick, or the lathe would not be oriented with the workpiece. This in turn would produce the need for a computer to make the tremendous multitude of calculations: every excursion of the tool would require a programing from the zero point for every distance traveled.

Tool positioning accuracy in such a system could be fantastically high, if the electronic components are properly tuned, because of the error-correcting function. Positioning to ten-thousandths of an inch might be feasible, although this is not to say that the finished work would be accurate to such a fine degree, as the lathe itself may not be sufficiently responsive, or sufficiently rigid, to carry out the precise control signals to the required extent. The question is, then, is all this equipment, and this high degree of precision, really necessary in an *engine* lathe?

The better way

Barber-Colman engineers didn't think so, and they set out to develop a numerical control engine lathe that would be as simple as possible, would have a minimum amount of auxiliary equipment, and would still do all the work that an engine lathe is expected to do within the usual engine lathe tolerances. They started out, not taking an existing lathe and adding a control, but working out a system whereby the control would be built right into the machine, commencing with the controls that actually produce tool travel in lathes.

Working with these controls, they devised a method whereby *given increments of travel* could be produced in direct response to taped signals. They built a reliable system of clutches and differentials which makes possible the picking off of a variety of increments, increments that can be used singly or in combinations to cover any given distance with mechanical precision, arriving at any point within an accuracy of .001".

Their system involved no feedback reading, simply direct tool movement in response to the taped program. The movement of the tool is as direct and positive as the movement of one carriage space that results from one tap on a typewriter space bar. And it turned out to be a highly flexible system, also. By programing different increments of travel simultaneously on both the longitudinal and transverse axes, 700 different tapers can be cut, tapers that are smooth and step-free. It is also practical to program simple radii, chamfers and similar forms. Operations of this sort can be precalculated, then dropped in as appropriate in the form of subroutines.

Such a timesaving procedure is possible only in a system which is not tied to a fixed zero point. Systems which do have such a zero point must substitute a computer for a set of subroutines, since every point on a form (such as a radius) must be related to the zero point.

So, the new Tape-r-guide lathe emerges as a simple, closely integrated, computerless machine, having no separate consoles, no involved electronics. It has no need for memory circuits, since any memory function that is required can be coded right on the tape . . . the least expensive place to put it!

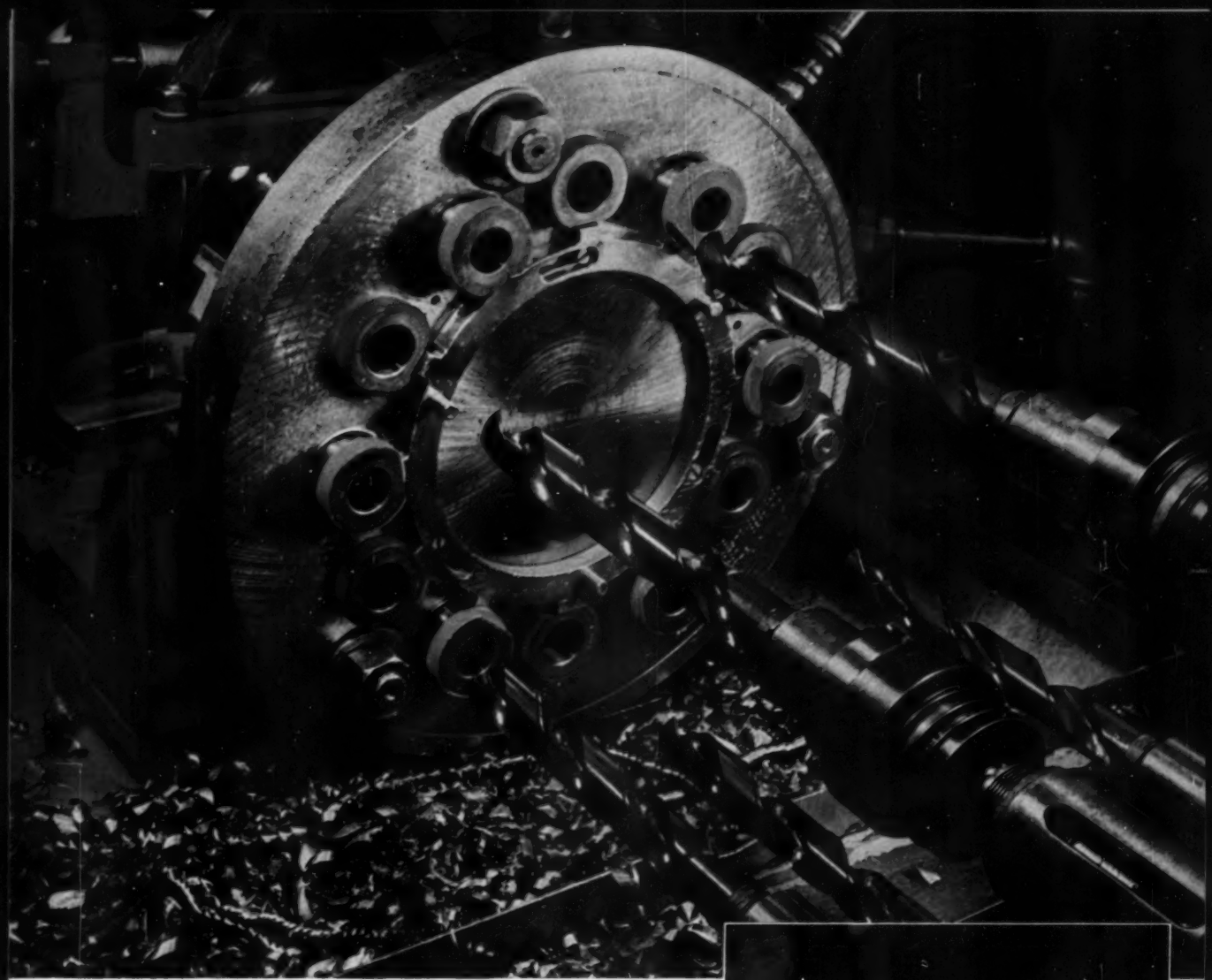
It is a machine that gives you *only what you really need* to capture the wonderful benefits of numerical control. For this reason, it is offered at a price that can put it in every progressive job shop.

Why not talk Tape-r-guide with your Barber-Colman representative —today?

Barber-Colman Company

BARBER COLMAN

610 Loomis Street, Rockford, Ill.



HIGH SPEED PRODUCTION
requires drills of *highest quality*

CLE-FORGE High Speed Drills produce more holes per grind . . . faster . . . and at lower cost. They do this consistently, on job after job, because of the QUALITY which is built into them. From the selection of the proper steel, through each manufacturing operation and many inspections, no effort is spared to make them the finest and most economical drills you can buy.

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for CLEVELAND ◇ Quality Tools . . . *prompt delivery from stock*

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One of many heat treating furnaces, where time and temperature are precision controlled to assure highest quality in CLE-FORGE High Speed Drills.

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P. O. Box 6656 • 1242 East 49th Street • Cleveland 1, Ohio

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Skilled craftsmen, using the most modern equipment, insure that BAY STATE Taps measure up to highest quality standards.

It takes *rugged tools* to tap 25,000 HOLES PER HOUR

BAY STATE Taps have the strength and stamina to reduce costly down-time on the high speed set-up shown above. Their built-in QUALITY is your assurance of dependable performance on all jobs, whether large or small. Every step in their manufacture is quality controlled to meet your most exacting requirements for high productivity and long tap life.

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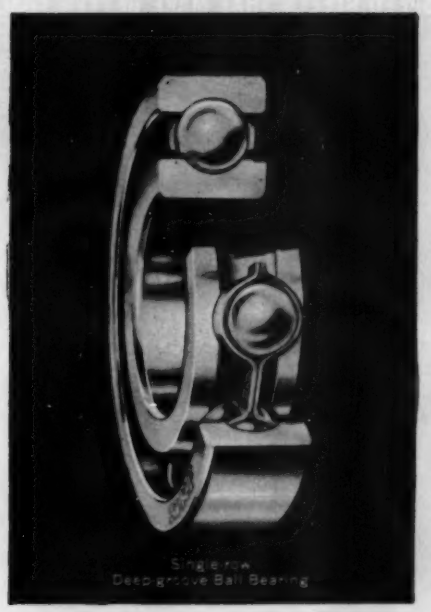


Can a standard bearing offer you "more bearing" for your money?

It can if it's made by SKF—because all SKF bearings, both ball and roller, offer special qualities at "production" bearing prices.

Take the single-row deep-groove ball bearing featured here, as an example. SKF designs and builds this type to sustain heavy radial load and thrust load in either direction. Furthermore, it is engineered to run smoothly and quietly at normal speeds with grease lubrication—and at high speeds with oil.

Yet this is a standard SKF ball bearing, mass-produced by automated production equipment at our plant at Altoona, Pa. You can quickly get this bearing in over 100 sizes, ranging from 5/8" to 15.748" O.D., and in a variety of seal, shield and snap-ring combinations.

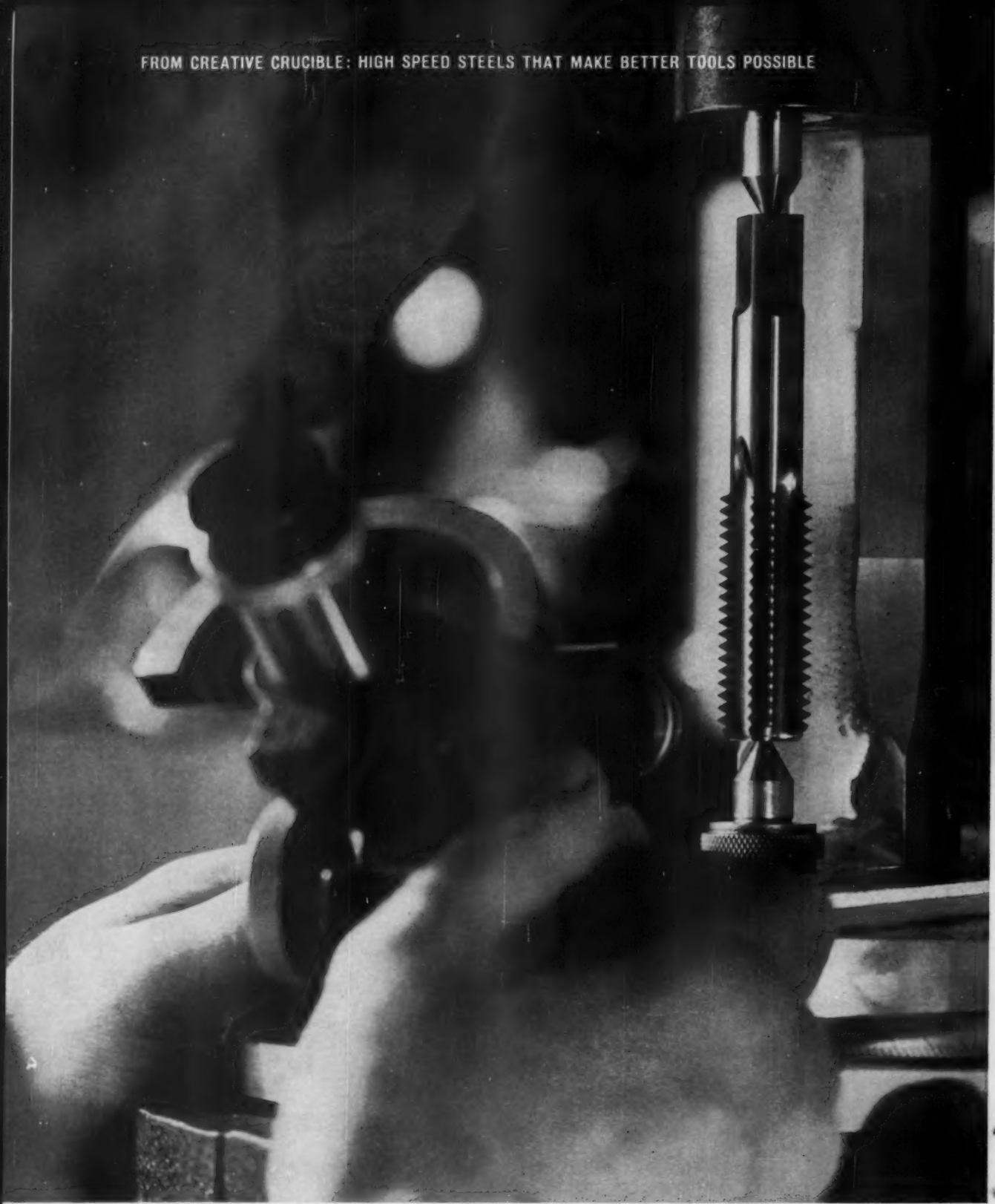
But why not find out what SKF offers in bearing quality, availability and economy? Just call the SKF branch office nearest you.

6001

Spherical, Cylindrical, Ball, "Tyson" Tapered and REED Miniature Bearings

EVERY TYPE—EVERY USE
SKF
SKF INDUSTRIES INC. PHILADELPHIA 32 PA

FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE



AN INSPECTOR CHECKS A "BOTTOMING" TAP for accuracy of the rake of the cutting face. Rex High Speed Steels help tapmakers produce the clean, accurate cutting edges so vitally needed in today's taps.

CIRCLE 344 READER SERVICE CARD

TODAY'S TRUE-RUNNING TAPS
"TIGHTEN-UP" TOLERANCES

They produce more accurate threads—for closer fits
—because of continually-improved Rex® High Speed Steels

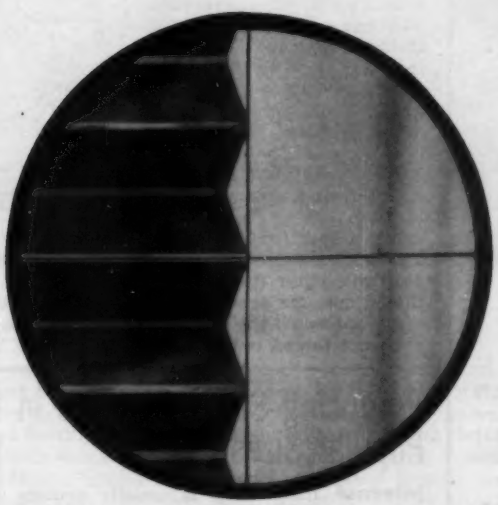
The ground-thread taps you now use produce more accurate threads—*and last longer*—even when tapping tough abrasive materials or today's high-strength alloys.

There's a story behind this development of more accurate and productive taps. It's the story of the tapmakers' continuing research and increasing skill—combined with Crucible progress in making better high speed steels.

To produce the fine steels needed for taps, Crucible tool steel specialists now use the most advanced electronic instrumentation available. For example: they can record the temperature of the molten metal in the melting furnace within 5 seconds. So, each heat is produced under identical temperature conditions.

Crucible specialists employ new techniques that also greatly improve deoxidation of the liquid steel. They use new ingot mold designs to minimize segregation. And they ultrasonically inspect every billet of Rex High Speed Steel before rolling or forging to ensure freedom from internal voids, flake, inclusions, etc.

For complete information on how Rex High Speed Steels can help make precision tools better, call or write Crucible branch office or service center near you.



THE RAKE ANGLE of a ¾-10 H5 "bottoming" tap looks like this — when viewed through the rake measuring instrument shown at left.

BETTER TOOLS, THROUGH BETTER STEELS. The constant improvement of Rex High Speed Steels ensures the increasingly better performance of hobs, broaches, twist drills, cutters and taps.

CRUCIBLE STEEL COMPANY OF AMERICA

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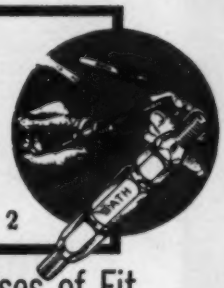
CIRCLE 345 READER SERVICE CARD

BATH *Tap'n Gage* TIMES



Vol. 1 — A series of technical discussions that will be helpful in getting better results from tapping and gaging operations — No. 2

Subject: Screw Thread Classes of Fit:

Screw thread classes of fit have been set up for the purpose of assuring the interchangeable manufacture of screw thread parts. These classes include 1A, 2A and 3A, applied to external threads and 1B, 2B and 3B applied to internal threads. The requirements for a screw thread fit for specific applications can be met by specifying the proper combination of classes for the components. Most requirements however will be satisfied by selecting one of the following combinations:

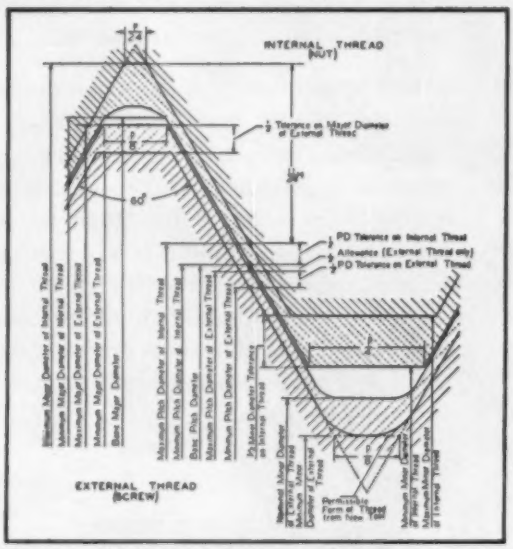


Illustration of tolerances, allowances and crest clearances for classes 1A, 2A, 1B and 2B.

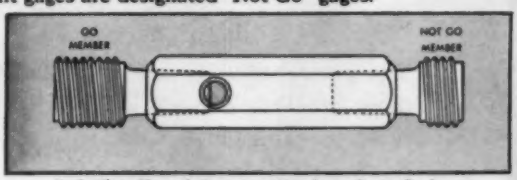
Classes 1A and 1B. These classes, 1A (external), 1B (internal) — are used on threaded components where quick and easy assembly is necessary and where a liberal allowance is required to permit ready assembly, even with slightly bruised or dirty threads.

Classes 2A and 2B. These classes, 2A (external), 2B (internal) — are designed for screws, bolts and nuts. They are also suited for a wide variety of other applications. An allowance is provided which minimizes galling and seizure encountered in assembly and use. It also accommodates to a limited extent, platings, finishes or coatings.

Classes 3A and 3B. These classes, 3A (external), 3B (internal) — are provided for those applications where closeness of fit and accuracy of lead and angle of thread are important. These threads are obtained consistently only by use of high quality production equipment, supported by a very efficient system of gaging and inspection.

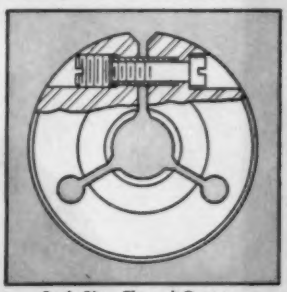
Gaging the Various Classes of Fit

Limit gages are the most effective and economical means for controlling screw thread classes of fit. Maximum metal-limit gages are designated "Go" gages and minimum metal-limit gages are designated "Not Go" gages.



Bath Plug Thread Gage — American Gage Design.

"Go" gages check or control the extent of the tolerance, as applied to a specific screw thread, in the direction of the limit of maximum material and represent the maximum limit of external threads and the minimum limit of internal threads. The ideal gage for internal threads is a "Go" plug thread gage and for external threads, a "Go" ring thread gage. "Not Go" gages control the extent of the tolerance in the direction of the limit of minimum material and represent the minimum limit of external threads and the maximum limit of internal threads. The use of "Not Go" plug thread gages and "Not Go" ring thread gages provides a satisfactory means of gaging for controlling effective size at the minimum material limits.



Bath Ring Thread Gage — American Gage Design.

More simply stated, plug and ring thread gages will satisfactorily inspect threaded components for assembly. Threaded parts will "pass" inspection if the "Go" thread plug will enter the threaded hole and the "Go" ring will thread onto the screw. At the same time, the "Not Go" plug must not enter the threaded hole and the "Not Go" ring must not thread onto the screw more than 3 turns.

Producing Screw Threads in the Popular Sizes

Internal threading is usually accomplished with taps, the pitch diameter or H Limit of which is selected according to the class of fit to be produced. Taps are available as standards in a variety of H Limits and will produce the desired class of fit when used as recommended.

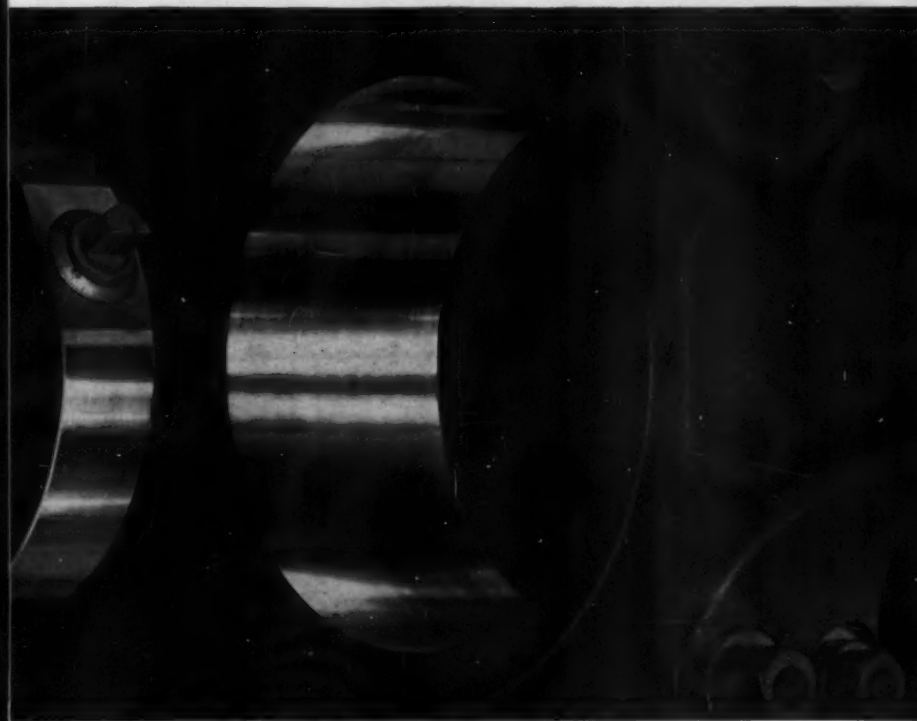
External threading is accomplished with dies, thread milling cutters or other threading tools and the size of the work is governed by the adjustment of these tools.

For further reference, see U.S. Dept. of Commerce, National Bureau of Standards Handbook H28 (1957) Part I.

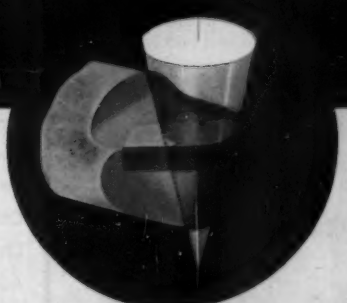
Cylindrical and Thread Gages Ground Thread Taps Internal Micrometers John BATH & Co., Inc.
22 Mann Street, Worcester, Mass.

NEW FROM FAIR STREET • HOME OF MICROBORE

titanium carbide and ceramic tipped microbore adjustable tooling!



Minimum overhang between cutting tip and cone seat assembly reduces deflection, assures extended tool life.



Cone relief has uniform clearance around profile of cutting edge for maximum tool life.

Cone Relief Ground Like All Microbore Tips!

High cutting speeds! Microbore titanium carbide and ceramic tips cut at speeds and feeds impossible with any other type tips, yielding excellent surface finish . . . in some instances comparable to ground finish. Micrometer vernier adjustment sets the tool point in seconds to accurate part dimensions. Extreme rigidity of basic design, double cone bearing and axial locking force; plus minimum tool point overhang, makes Microbore ideal for these new cutting edges. *Like all Microbore cutting tools, the new tips are cone relief ground to gage room accuracy.* Microbore titanium carbide and ceramic tipped tooling are major developments in the complete Microbore system of precision cutting tools.

Ask your Microbore distributor for complete information or write for Microbore catalog.

DeVlieg® Microbore® System

DEVLIEG MICROBORE • DIVISION OF DEVLIEG MACHINE COMPANY

Fair Street · Royal Oak, Michigan

Chip flow to the rear of the machine for easy removal.

36 spindle speeds in a range of 8 to 1000 R. P. M.

Four-way variable speed power rapid traverse.

Power tailstock positioning on flame hardened bed ways.

No chip pan obstruction at front of machine.

Tailstock design permits setting compound rest parallel to work axis.

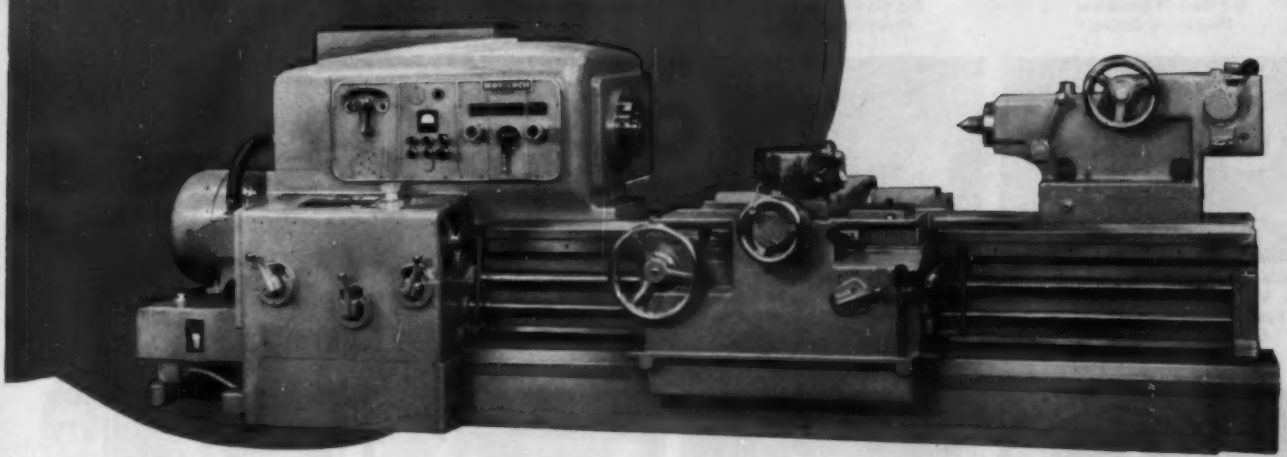
Check the Model 3220, feature for feature, against any other heavy duty lathe of similar swing capacity. Here are the major plus values. Add them up and you get only one answer — greater productivity hour after hour — day after day — year after year. This is worth investigation!

	Monarch Model 3220	Other 25" Or Model 3220 Machines
Number of spindle speeds	36	?
Speed range	8 to 1000 R. P. M.	
Surface cutting speed automatically calculated	Yes	
Hole in headstock spindle	3 1/16"	
Spindle jog	Automatic	?
Headstock lubrication	Mist	
Attention-free hydraulic clutch and brake	Yes	
Swing over bed and carriage wings	32"	?
Bed width	26½"	
Totally enclosed end gearing	Yes	
Four flame hardened and precision ground bed ways	Yes	
Chip flow to rear for easy removal	Yes	?
Chip pan obstruction at front	No	
Automatic traveling rod supports	Yes	
Variable speed power rapid traverse to carriage and cross slide	Yes	
Automatic disengagement of apron handwheel and cross feed dial during traverse	Yes	?
Apron handwheel and cross feed dial pick-up at same spot after traverse	Yes	
Feed range	.003" to.1683" per rev.	?
Backlash eliminator when using taper attachment	Yes	
Tailstock spindle diameter	6½"	
Power tailstock positioning	Yes	?
Anti-friction tailstock spindle suitable for drilling, tapping and reaming	Yes	
Tailstock design permits setting compound rest parallel to bed ways	Yes	?
Stock removal, cu. in. per minute, up to	92	
Net weight of base length (48") machine	19,660 lbs.	

YOU GET MORE...
YOU PRODUCE MORE

with the Monarch Series 80
Heavy Duty Dyna-Shift Lathe—Model 3220

(ON DESIGNS DESIGNATED AS 25" LATHES)



You'll suffer — competitively — if you tool up today with yesterday's lathes for the boom of the Soaring Sixties. The Monarch Series 80 is truly the lathe of tomorrow, as are the other new Monarch high production and special purpose lathes. Send for our illustrated Booklet #1603 for full Series 80 information — or state your other interests.

Monarch
TURNING MACHINES
ACCURACY • ECONOMY • LONG LIFE

THE MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

2509 Engine Lathe
The American Tool Works Company
G-E Mark II Numerical Positioning
Control with Two-Dimension Tracer

Travelling 19-inch Column Openside
Boring and Drilling Machine
The American Tool Works Company
G-E Mark II Numerical
Positioning Control

Turr-e-tape Six-spindle
Turret Drilling Machine with
B&S 15" by 20" Positioning Table
Brown & Sharpe Manufacturing Co.
G-E Mark II NPC

Numericam Cam Milling Machine
Brown & Sharpe Manufacturing Co.
G-E Mark II Numerical
Positioning Control

Burgmaster Eight-spindle
Turret Drilling Machine
Burg Tool Manufacturing Co., Inc.
G-E Mark II Numerical
Positioning Control

Burgmaster Eight-spindle
Turret Drilling Machine
Burg Tool Manufacturing Co., Inc.
G-E Mark II Numerical
Positioning Control

Spindlemaster with Automatic
Tool Changer for Drilling,
Tapping, Boring, and Milling
Cleereman Machine Tool Corporation
G-E Mark III NPC

Edlund-Matic* Drilling and
Tapping Machine
Edlund Mach'y Co. Div., Harsco Corp.
G-E Mark II NPC
*Trade-mark

Milwaukee-Matic Model II Drilling,
Milling, and Boring Machine
Kearney and Trecker Corporation
G-E Three-motion Numerical
Positioning Control

Milwaukee-Matic Model II Drilling,
Milling, and Boring Machine
Kearney and Trecker Corporation
G-E Four-motion Numerical
Positioning Control

They stole

Vertical Knee-type Milling Machine
Kearney and Trecker Corporation
G-E Mark Century Numerical Control

Tape Turn Lathe
The R.K. LeBlond Machine Tool Co.
G-E Mark Century Numerical
Contouring Control

Hole Locator and Twin Head Drilling
Machine for Printed Circuit Boards
Leland-Gifford Company
G-E Mark II NPC

Single-spindle Drilling Machine
Leland-Gifford Company
G-E Mark II Numerical
Positioning Control

Five-inch Horizontal Boring,
Drilling, and Milling Machine with
Automatic Tool Changing
Lucas Mach. Div., New Britain Mach. Co.
G-E Mark III NPC (Numra-tronic)

Five-inch Floor-type Horizontal
Boring, Drilling, and Milling Machine
Lucas Mach. Div., New Britain Mach. Co.
G-E Mark II-M NPC with
Accupin Feedback (Keytronic)

Vertical Spindle Machine with
Automatic Tool Changer
Sundstrand Corporation
G-E Mark III Numerical
Positioning Control

Turret Punch Press
Wiedemann Machine Co.
G-E Mark II Numerical
Positioning Control

CIRCLE 350 READER SERVICE CARD

Burgmaster Six-spindle
Turret Drilling Machine
Burg Tool Manufacturing Co., Inc.
G-E Mark III Numerical
Positioning Control

Burgmaster Six-spindle
Turret Drilling Machine
Burg Tool Manufacturing Co., Inc.
G-E Mark II Numerical
Positioning Control

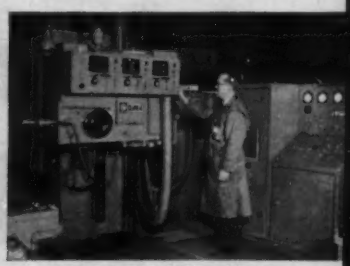
Burgmaster Six-spindle
Turret Drilling Machine
Burg Tool Manufacturing Co., Inc.
G-E Mark II Numerical
Positioning Control

Burgmaster Eight-spindle
Planer-type Turret Drilling Machine
Burg Tool Manufacturing Co., Inc.
G-E Mark II Numerical
Positioning Control

Continuous Path 3-dimension
Profiling and Scribing Machine
Ekstrom, Carlson & Company
G-E Numerical
Contouring Control

Layout Drilling Machine
Fosdick Machine Tool Company
G-E Mark II Numerical
Positioning Control

Fosmatic Turret Drill—32 Spindles
with Automatic Depth Control
Fosdick Machine Tool Company
G-E Mark II Numerical
Positioning Control



DiMil—Contour Milling Machine
Giddings & Lewis Machine Tool Co.
G-E Three-motion Numerical
Contouring Control

the show in Chicago!

Each of these automatic machine tools—featuring General Electric numerical control—was a "hit" at this year's Machine Tool Exposition. Collectively, they demonstrate metalworking's broad acceptance of automatically controlled machines . . . acceptance that is paying off in increased productivity, greater machine utilization, and elimination of special tooling cost. For complete details on these automatic machines, see the machinery builder or your General Electric Sales Engineer. Specialty Control Dept., Waynesboro, Va.

795-12A

Progress Is Our Most Important Product

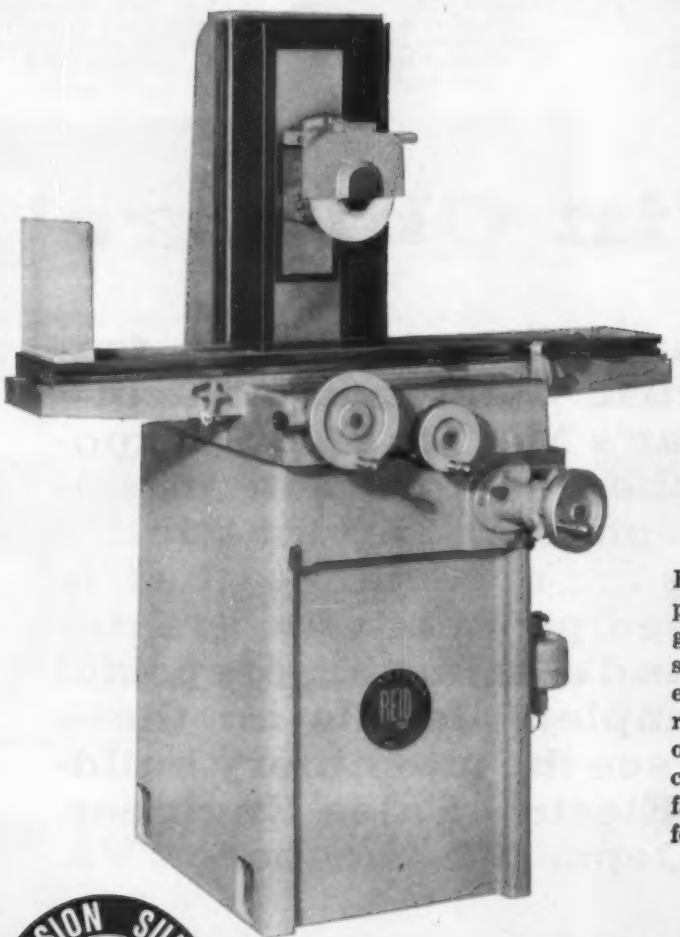
GENERAL ELECTRIC

CIRCLE 351 READER SERVICE CARD

REID

INDUSTRY'S NO. 1 CHOICE...
SEE IT... COMPARE... CHECK THESE EXTRAS!

618 HR ROLLERWAY



- BETTER DESIGN... GREATER VALUE
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- HEAVY CONSTRUCTION THROUGHOUT FOR UNIFORMITY
- PRECISION GROUND MATCHED ROLLERS
- VIBRATION-FREE PERFORMANCE
- CONVENIENT EASY-TO-READ HAND WHEELS
- QUALITY RESULTS... LOW COST

REID's newest surface grinder, *the 618 HR* provides the easiest moving hand operated grinding table on the market. Heavier in construction with precision ground, matched rollers, the Reid 618 HR results in greater accuracy at lower cost. Check the important extras on REID grinders...compare work results... compare price . . . and you'll agree; Reid surface grinders are industry's number 1 choice for value!

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PRECISION SURFACE GRINDERS

REID BROTHERS COMPANY, INC. / 140 ELLIOTT ST. / BEVERLY, MASSACHUSETTS

✓STAINLESS BAR AND WIRE?
✓TOOL AND DIE STEELS?
✓HIGH SPEED AND MOLD STEELS?

We've got 'em in stock . . . in shapes, sizes and lengths to meet your needs

Order specialty steels from your local Universal-Cyclops Specialty Steel Service Center and gain these cost-reducing advantages:

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A leading producer of specialty steels for over 75 years, Universal-Cyclops continues to supply you with highest quality steels, expanded services and stocks, and specialized technical assistance to help solve your metalworking problems.

Call or write for your latest copy of the Universal-Cyclops Stainless Steel Stock List on Billet, Bar and Wire.

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L+I gives you the edge on production

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LAVALLEE & IDE, INC.
CHICOPEE, MASS.

LETTERS

to the editors

330 W 42nd St, New York 36, NY

Higher Grinding Speeds

Dear Sirs:

Been reading the Chicago Show Report (*AM/MM* — Sept 19 '60, p109). Nice report, good show, sorry I missed it. Been too busy. Yes, said too busy!

On p115, read that Norton has upped the speeds of grinding wheels from 6000 sfm to 8500 sfm. All I can say is ho hum, ho hum, and say it very quietly.

Back in 1945 the very wise Norton engineers told the writer that he was a complete idiot to think that 12,000 to 18,000 sfm for grinding was better. Perhaps the boys at Norton are coming awake.

Being the idiot that the grinding wheel manufacturers and the grinding industry so dubbed me, and not knowing better, I put a good heavy guard over the wheel and proceeded to grind at 16,000 sfm. Sure, we exploded a few wheel and a few tempers, but, boy, what nice work, and the quantity of it. The exploded wheels have faded away and are forgotten.

Proof? Why sure. Read the *AM* article called "Extruded shapes and special machines cut costs" (*AM*—June 3 '57, p106) and note the second column on p108. And, Mr DeGroat, when I designed that machine and supervised the building of that machine, the speed was 16,000 sfm instead of 12,500 sfm, and the production rate was closer to 9000 pieces per hr than 4000 pieces per hour.

Said I was busy. Sure, still busy doing things that wise people tell me can't be done.

Del Leslie
Troy Research & Development Co
Div of Associated Research
Troy, Mich

Reader Leslie does not state what type of wheel he is using at these high speeds, but the 1957 article says, ". . . 18-in.-dia resinoid-bonded wheels are used, running at 12,500 sfm. . . ." This kind of wheel, usually employed for cut-off work, is suitable for speeds from 6000 to 16,000 sfm, according to the ASA Safety Code.

However, to set the record straight, most grinding is performed with vitrified or silicate-bonded wheels, not considered safe above 6500 sfm.

SHOPMATES

N. Jarvis

... THEY ESTIMATED FIVE HOURS ON THIS PART AND I DID IT IN FOUR AND A HALF !! .... NOW WHO DO I CHARGE FOR THE JIGS AND FIXTURES I HAD TO HAVE TO MAKE THE PART ?? THERE'S SEVEN HUNDRED HOURS ON THEM .... I CAN'T PAD THE FIVE HOURS THAT MUCH .... OR CAN I ??
N. JARVIS

Still using the gay nineties approach to Tool Steel?

Use the New, Modern A-L Steelector System

Now you can accurately select the proper tool steel based on its individual characteristics and be sure that it's available for off-the-shelf delivery before you place your order.

The new Allegheny Ludlum STEELECTOR Program makes tool steel selection fast. And it eliminates the embarrassment of specifying a grade which later turns out to be unavailable or available only after a costly delay.

The leading grades of tool steel that meet 96 percent of all applications—as listed in the Allegheny Ludlum Tool Steel Handbook—form the basis of the STEELECTOR Program. The STEELECTOR Grades are charted on cards covering each group of steels (tool room, hot work, and high speed grades) to help you select the particular grade best for your application.

Bar graphs on each STEELECTOR Card show how the various grades compare in abrasion resistance, toughness, size stability, machinability and red hardness. It's easy to determine accurately the combination of properties that best suits the job at hand.

The complete necessary range of sizes and shapes is listed in a special Data Stock List for every grade. These lists also include heat treating, typical working hardnesses and other data to insure that your selection is correct.

You can choose with confidence because every STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the rigid quality control standards of all A-L products.

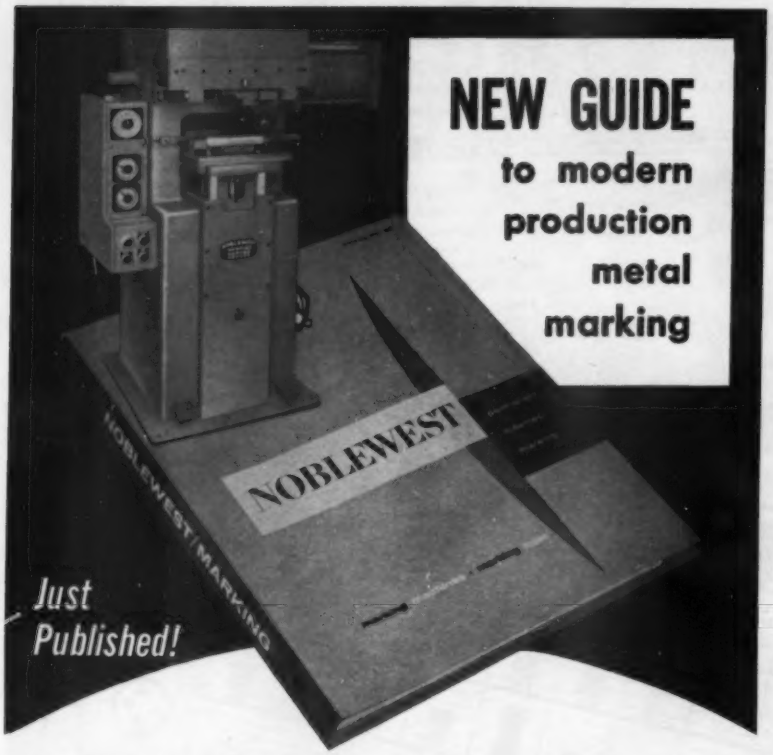
For a complete explanation of the STEELECTOR Program, ask your Allegheny Ludlum sales representative for a copy of the colorful A-L Tool Steel STEELECTOR Booklet, or write: *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. AM-11.*

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

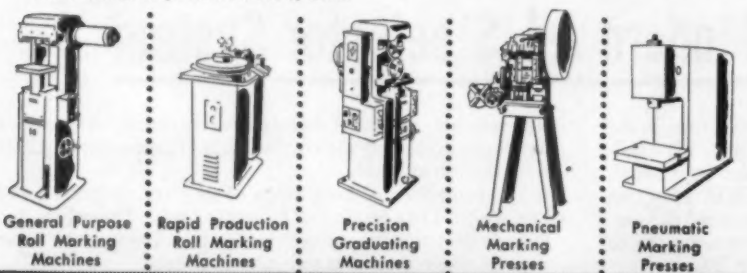
Tool Steel warehouse stocks throughout the country

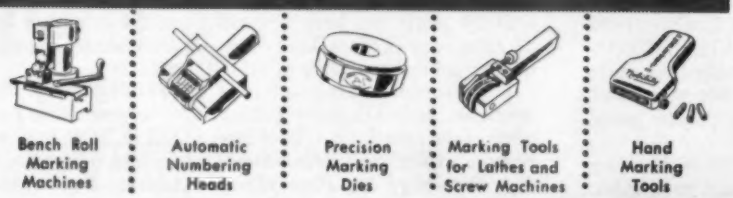
8083



TO mark what you make . . . to mark it well . . . to mark it *permanently* is essential to modern manufacturing and marketing. To *mark it best with Noblewest* has become a tradition with leaders throughout the industry, for Noblewest marking is *permanently indented* marking . . . and Noblewest equipment marks faster, better, at lower cost.

The basic types of Noblewest marking equipment are illustrated below. Our new catalog is a most comprehensive guide to the selection of marking machines and marking tools. For a copy write Noble & Westbrook Manufacturing Company, 17 Westbrook Street, East Hartford 8, Conn.




Bench Roll Marking Machines
Automatic Numbering Heads
Precision Marking Dies
Marking Tools for Lathes and Screw Machines
Hand Marking Tools

MARK IT BEST WITH NOBLEWEST IMPROVED MARKING DEVICES

NOBLEWEST

ORIGINATORS OF THE ROLL MARKING PROCESS

MARKING
NUMBERING
EMBOSSING
GRADUATING

The Norton Co has, in fact, pioneered in this area with a jump of better than 30% in top speed. At the same time, we should point out that Norton recommends this kind of speed only with its own specially graded, vitrified wheels. —Ed.

U S Tools vs Imports

Dear Sirs:

While attending the Machine Tool Exposition in Chicago, I had occasion to discuss foreign machine tools and their relation to the American machine tool manufacturers and distributors.

It seems to me a very simple matter to correct any faults in the present manufacturer-dealer relationships. After all, the manufacturer and the dealer have signed a contract. The manufacturer agrees to grant exclusive protection to the dealer in his territory, and the dealer agrees to promote aggressively the sale of the manufacturer's equipment.

Both parties to such a contract should consider it binding. If the dealer stocks or sells a foreign machine that competes with the type of equipment the manufacturer furnishes, the manufacturer can simply cancel the contract.

The day that both parties to an exclusive sales contract have to comply with its stipulated conditions and requirements, we, as distributors, will have to get back to trying to sell the features of American-made machine tools.

No doubt many people will disagree with this view. However, if we are to keep the American machine tool industry capable of taking care of a sudden emergency, manufacturers and dealers alike have got to work on a real, hard-selling program.

Eugene F Dawson
Dawson Machinery Co
Seattle, Wash

"It's not hard work—but it's the same old grind everyday."

CALENDAR

American Society of Mechanical Engineers — Winter Annual Meeting, Nov 27-Dec 2, Statler Hilton Hotel, New York, NY.

Joint National Symposium on Reliability and Quality Control, Jan 9-11, Bellevue Stratford Hotel, Philadelphia, Pa.

Society of Automotive Engineers —International Congress and Exposition, Jan 9-13, Cobo Hall, Detroit, Mich.

Instrument Society of America—Instrument-Automation Conference & Exhibit, Jan 16-19, Kiel Auditorium, St Louis, Mo.

Plant Maintenance & Engineering Show—Jan 23-26, International Amphitheatre and Palmer House, Chicago, Ill.

Society of Plastics Engineers—Annual Technical Conference, Jan 24-27, Shoreham Hotel, Washington, DC.

Society of the Plastics Industry —Reinforced Plastics Div Conference, Feb 7-9, Edgewater Beach Hotel, Chicago, Ill.

Material Handling Institute — Pacific Coast Show, Feb 22-24, Cow Palace, San Francisco, Calif.

Society of Automotive Engineers —National Automobile and Production Meetings, Mar 13-17, Sheraton-Cadillac, Detroit.

American Society for Metals—Western Metal Show, Mar 20-24, Pan-Pacific Auditorium, Los Angeles, Calif.

Pressed Metal Institute — Spring Technical Meeting, Mar 22-24, Belmont Plaza Hotel, NY.

Society of Automotive Engineers —National Aeronautic Meeting, Apr 4-7, Hotel Commodore, New York, NY.

American Welding Society—Annual Meeting and Welding Show, Apr 18-20, Commodore Hotel and Coliseum, New York.

American Foundrymen's Society —Castings Congress & Exposition, May 8-12, Brooks Hall and Civic Auditorium, San Francisco, Calif.

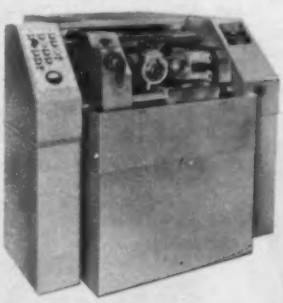
REED

High Speed- Thread Rolling Machine

Up to 200 Pieces Per Minute

with cylindrical single revolution dies

The Reed B910 Cylindrical Die Thread Rolling Machine is a rugged general purpose two-die type machine for high speed production. This machine is adaptable to a wide range of work using single revolution dies where the parts are rolled within one revolution of the dies. Diameters $\frac{3}{16}$" through 1" and thread lengths up to $6\frac{1}{2}$" long may be rolled.



The machine is simple to set up and convenient to operate. Both semi- and completely automatic work-handling equipment is available to take full advantage of the high production capabilities of the machine.

Write for Machine Bulletin B-910-1

REED B-910-1

REED ROLLED THREAD DIE CO.

Specialists in Thread and Form Rolling Tools and Equipment

HOLDEN, MASSACHUSETTS, U. S. A.

Sales Offices in: Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

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the complete line Butterfield hand taps are top performing and long lasting, like the rest of *the* complete line: spiral point taps, drills, reamers, dies, counterbores, cutters, end mills, hobs and carbide tools. Phone for quick deliveries or technical aid. Warehouses in Chicago, Detroit, Fort Worth, Los Angeles, New York and San Francisco. **Call your Butterfield Distributor.**

BUTTERFIELD

DIVISION, Union Twist Drill Company, Derby Line, Vt.

PRODUCTION POINTERS from GISHOLT

More cost-cutting IDEAS– to help you

HOW IHC SUPERFINISHES BEARING RACES 300% FASTER

Superfinisher® with automatic work handling cuts time, improves quality

Here is an excellent example of how new equipment, properly applied, offers dramatic cost and time savings. In use at International Harvester's West Pullman Works, Chicago, Illinois, this Gisholt Model 79A Bearing Race Superfinisher handles tapered inner bearing track surfaces on a wide variety of inner bearing races, 2½″ to a maximum O.D. of 4¼″.

Here is the operation on an inner bearing race with a 12° taper and a 2⅜″ bore. Ground parts are placed in a gravity loader. A pocket wheel indexes the work to chucking position. The tailstock moves the part over an arbor for chucking in the I.D. The Superfinishing stone engages the outer track surface. At the end of the automatic cycle, the stone and tailstock retract, and spring-loaded pins eject the part. The pocket wheel indexes a new workpiece into position, at the same time discharging the finished part. F.t.f. time, 10 sec.

Different part sizes are accommodated by adjustment of loader tracks and replacement of the pocket wheel, arbor sleeve and Superfinishing stone. The quill is adjusted for angle and diameter. Separate sets of dial controls adjust spindle speed, stone pressure, reciprocation rate and stone contact time.

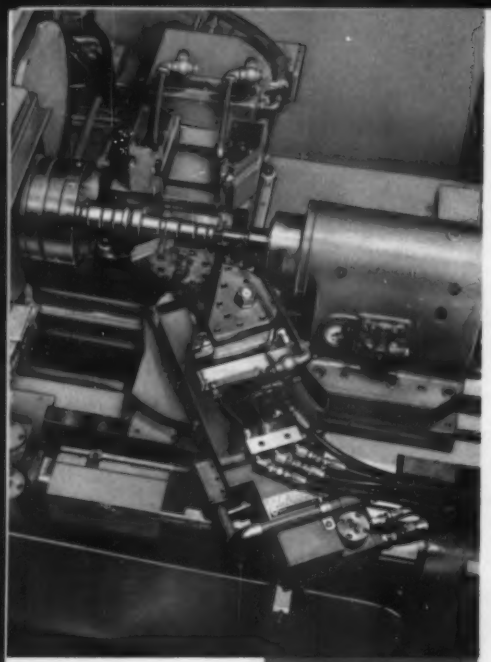
Superfinishing eliminates one grinding pass, provides better surface faster. Former methods required two grinding passes—the second to bring the surface from 60 to 25 micro-inches RMS in 25 sec. Next the races were Superfinished to 8 micro-inches RMS in 30 sec. Now the races are Superfinished from 60 to 8 micro-inches RMS in only 10 sec.

View from rear of machine showing Superfinishing stone engaging workpiece and Superfinished part in discharge conveyor.

Rough workpiece at top. Superfinished part at bottom has a "controlled" 8 micro-inch RMS finish after fast, 10-sec. Superfinishing operation.

For information on Superfinishers circle or write in No. 736 on inquiry card.

MASTERLINE® 79A Bearing Race Superfinisher. Note dial controls at left which govern basic machine functions and speed setup. Gravity loader holds number of rough parts. Full automatic operation frees operator to handle additional units or perform other work.



JETracer, operating within automatic cycle of No. 12 Automatic Production Lathe, makes short work of stepped shaft job. Second operation shown. The JETracer handles the stepped diameters and contours, using four different templates for each operation. Necking, grooving and chamfering are completed from the rear independent slide.

For information on JETracing, circle or write in No. 737 on inquiry card.

EASY WAY TO HANDLE STEP SHAFTS

Speeds setup, reduces inspection, cuts tool costs

Step shaft jobs couldn't be easier when you've got a No. 12 Automatic Production Lathe with a multiple-pass JETracer® operating within the automatic cycle.

All the work on the step shaft shown (12⅝" x 2¾") in the setup photo is completed in just two 4-pass operations.

Operation 1, on one end, takes just 5.0 min., f.t.f. Operation 2, shown — only 4.9 min., f.t.f.

The JETracer, mounted on the front carriage, has a 4-pass automatic indexing template carrier. An automatic indexing tool post on the JETracer slide presents a roughing tool on the first three passes, then a finishing tool on the final pass.

To handle similar parts requires only a change of tracing templates and grooving tools, and chamfer tool adjustments. Many shaft jobs may be completed in just two passes for each end. With such a setup, four templates would be used and the work turned end-for-end after the second pass. The entire part could then be completed in one machining cycle—eliminating the need for the banking of parts.

Rigidity and automatic cycle of No. 12 Automatic, combined with efficiency of multiple-pass JETracing, assure accuracy and economy.

UNIQUE AR® ADVANTAGES BOOST SMALL-LOT EFFICIENCY

Setup demonstrates combination of advantages offered for first time in ONE machine

Now for the first time the No. 5 AR Turret Lathe gives you the efficiency and consistent accuracy of automatic cycling, plus the versatility and quick setup of a hand-operated ram type turret lathe. And it handles BOTH BAR AND CHUCKING WORK. Take this 1" valve bonnet job, for

example. First operation (A) is a bar job; second (B), a chucking job. While both operations could easily be done on one AR—converting from bar to chucking in one hour or less—the volume of work here warrants the use of two AR's: one for bar work, the other for chucking.

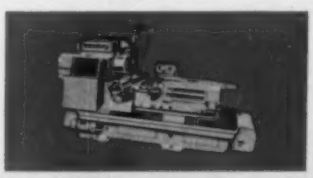
All external and internal surfaces in area A are machined in the first operation in only 3.3 min., f.t.f. An Air-draulic bar feed allows feeding of the 2½" bar stock right up to the collet pads.

Tooling for the second operation (chucking) is shown. All internal and external surfaces in area B are completed in only 2.1 min., f.t.f. Operations handled during the automatic cycle include: deep hole drilling with automatic chip clearing; internal and external threading; internal recessing; dwell for cleanup, and reverse feed for fine finish. Many of these operations would require a highly skilled operator if done on a hand-operated machine.

One operator easily handles two AR's—one for bar work, the other for chucking work. He keeps bar stock supplied on one, chucks and unchucks on the other, and removes finished parts.

AR (Automatic Ram) Turret Lathe averages 50% boost in productivity—extends tool life—assures consistent, close-tolerance quality.

For information on AR, circle or write in No. 738 on inquiry card.



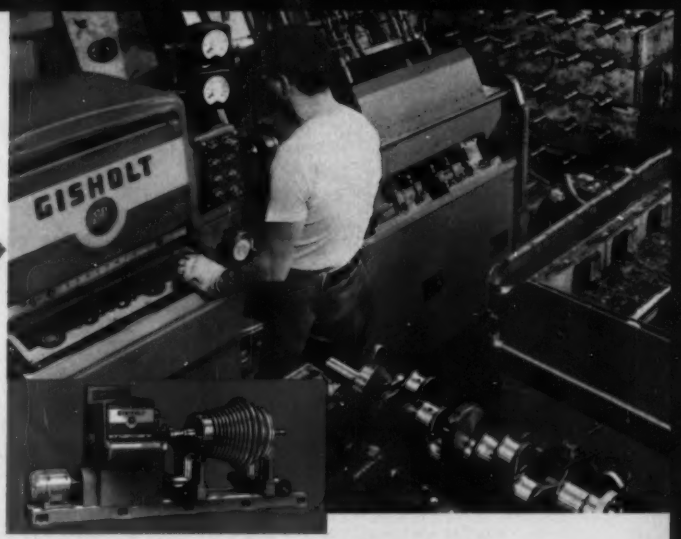
AUTOMATIC 10-STEP BALANCING ELIMINATES CHANCE OF HUMAN ERROR

Cycle includes measurement and location of unbalance, correction and inspection

Perhaps you can take advantage of the principles involved in this automatic balancing setup used by a well-known automotive manufacturer. Here two automatic Gisholt 2U Balancing Machines are an integral part of the crankshaft machining line.

Each machine is furnished with a ring (bob) weight eliminator, which offers considerable savings in tooling costs and work-preparation time—and two Leland Gifford multiple-spindle drilling units.

The crankshafts are manually loaded and unloaded. Balancing machine operation is completely automatic. In one continuous cycle it measures the amount and location of unbalance in each of two correction planes. It indexes to the exact angles for correction drilling and then inspects to assure balance within the ½ ounce inch tolerance.



Gisholt Automatic 2U Balancer setup measures amount and locates angle of unbalance in each of two correction planes, corrects by drilling, and inspects for balance in one, 100-second, automatic cycle. Note multiple-spindle correction drilling units to right of operator. Operator loads and unloads, couples and uncouples the drive.

If unbalance exceeds the maximum correction that can be made in one drilling, if unbalance falls outside the sectors in which correction can be made, or if residual unbalance exceeds tolerance, the machine stops and a signal light goes on.

A manual operation switch then permits the operator to reinspect the workpiece and make the necessary balancing correction.

The entire automatic sequence can be completed for the average part in 100 seconds, so the operator has ample time to handle two machines.

Ten operations for locating, measuring, correcting and inspecting for balance are quickly performed in one automatic cycle—eliminating human error, assuring that balancing tolerances are uniformly met on every part.

For information on balancing machines, circle or write in No. 739 on inquiry card.

NOW CRI-DAN OFFERS TRACING AND THREADING TO CUT YOUR COSTS

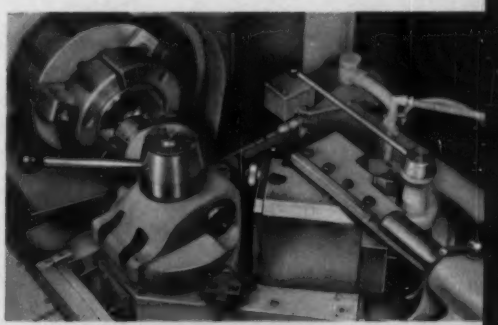
Single-point ceramic tracing and carbide threading operations combined in automatic cycle for top efficiency

This part, an accumulator cap of 1040 steel, was previously rough- and finish-machined, and then threaded, using collapsible die heads. It is produced in two different sizes. The manufacturer wanted to eliminate problems of holding size and meeting fine surface finish requirements. He also wanted to combine machining and threading on an automatic, and reduce tool, die and setup costs.

The answer, provided by a CRI-DAN E Automatic Threading Lathe, may help you in your own work. The illustrations and captions tell how the CRI-DAN handles contour-tracing and threading far faster than by previous methods.

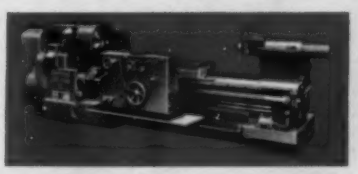
CRI-DAN E cuts time—combines tough internal contour-tracing and threading jobs in automatic cycle. Change-over for two part sizes takes approximately 15 min.

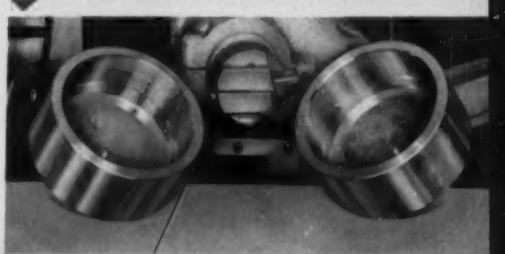
For information on CRI-DAN E, circle or write in No. 740 on inquiry card.



The part shown, 6¼″ diameter, 4⅛″ long, arrives at CRI-DAN rough-machined. It is held in special jaws to eliminate distortion. A triangular insert-type ceramic tracing tool is used, starting at the face, to face, chamfer, bore I.D., under-cut thread relief, bore seal diameter and face bottom of seal diameter. A machining speed of 700 to 800 s.f.m. produces a 50 micro-inch RMS finish on all surfaces. Triangular inserts provide six cutting edges with 12 pieces completed per edge.

The 1.450″-long, 5.375″-diameter, 16 NS-2B thread in the bore is then completed in 12 passes (.0015″ in feed per pass) by the single-point carbide threading tool. Note that both the tracing and the threading tools are mounted in the same holder. The thread is machined from the right-hand side of the part—starting at the base of the bore and feeding out to the face of the work.

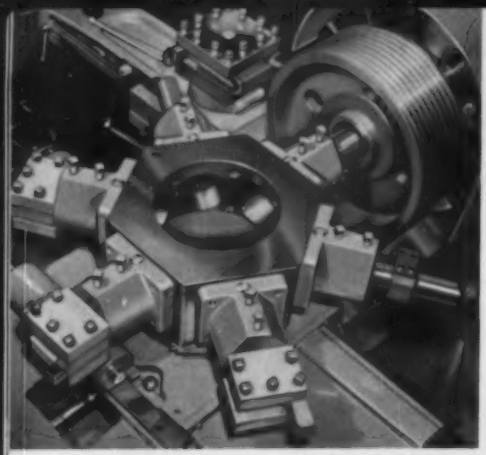




Close-up of the work and tooling. At right: ceramic threading tool and part showing surfaces traced. At left: carbide threading tool and thread produced in 12 passes.

GISHOLT SINCE 1887

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE



First operation setup. Cross-feeding hex turret tools bore, turn, recess, face, chamfer and groove I.D. Square turret tools turn O.D., face, chamfer and single-tool the V-belt grooves. Time, 73.9 min., f.t.f. Second operation is the same as the first except for grooving and boring. Time, 33.4 min., f.t.f. One set of tools handles both operations. Reversible chuck jaws speed change-over.

CROSS-FEEDING HEXAGON TURRET CUTS SMALL-LOT TOOLING COSTS

Full-swing side carriage permits handling larger work on less costly machine

Two important cost-cutting advantages are obtained by this setup on a Gisholt MASTERLINE 3L Saddle Type Turret Lathe:

1. A cross-feeding hexagon turret cuts tooling costs and reduces setup time for short-run work;
2. A full-swing side carriage (standard) permits swinging work up to 21¾″ diameter over the cross slide on the less costly 3L size machine.

You'll want to remember the way these advantages are used to machine 20¾″ diameter, 7″-wide cast iron V-belt pulleys in two operations.

Standard boring bars and cutter holders are mounted on the cross-feeding hex turret. These are used to bore, turn, face, recess, chamfer and groove I.D. *One* set of tools is used for *both* operations. A 6-position stop roll for the cross-feeding hex turret assures repeat accuracy on all cuts.

The full-swing side carriage permits moving the cross slide right up beside the almost maximum diameter part as square turret tools turn the O.D., face, chamfer, and machine the V-belt grooves. The nine grooves are single-tooled to eliminate distortion and provide a fine finish. The side carriage stop bar has special notches that assure accurate spacing of grooves with minimum operator effort.

Cross-feeding hex turret allows standard tools to handle multiple operations. With a taper attachment or JETracer control, even greater versatility can be obtained at minimum cost.

For information on saddle type turret lathes, circle or write in No. 741 on inquiry card.

ONE TAPE-CONTROLLED FASTERMATIC® OUTRUNS SIX OLDER MACHINES

Cuts f.t.f. time 85%, cuts setup time 68%, assures consistent accuracy

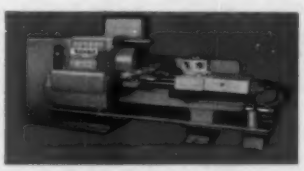
Imagine the savings on your short-run jobs with a setup like this in your shop. It combines the automatic cycle of a versatile Fastermatic Automatic Chucking Turret Lathe with the fast setup and small-lot flexibility of point-to-point, punched-tape PRODAC control. Westinghouse Corp., Motor and Control Division, Buffalo, New York, is the user.

Here the operator sets his tools, inserts the tape in the reader, takes his trial cuts, makes his final tool adjustments, and starts the automatic cycle. Hand setting of stops and trip dogs, and selection of spindle speeds, feed rates and machine functions, are eliminated—all having been programmed on the tape.

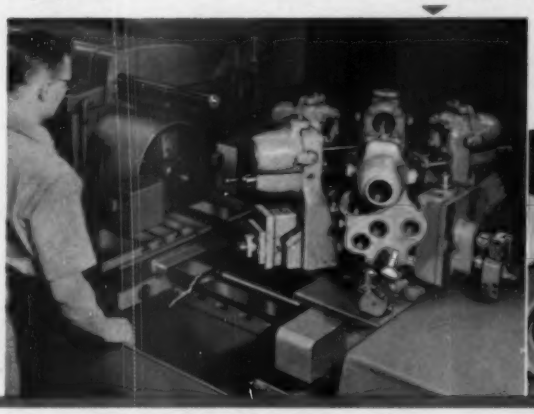
The tape-controlled Fastermatic used by Westinghouse handles a great variety of work formerly requiring six machines. Consistent production rates, long tool life and uniform quality are important benefits.

IF Fastermatic, with point-to-point punched-tape control, outproduces six older machines on variety of small-lot work. Engineering department has complete control; operator-influenced variables are eliminated.

For information on punched-tape PRODAC-controlled Fastermatic, write in or circle No. 742 on inquiry card.



Setup used by Westinghouse for machining two sides of nodular iron commutator V-rings, 4½″ diameter, 1⅜″ wide. Point-to-point, punched-tape PRODAC-controlled Fastermatic cuts previous setup time 68%, cuts f.t.f. time 85%. (Below) Rough ring and both sides of finished part. One side machined from hex turret stations 1 and 2, and front cross slide. Other side handled from stations 3 to 6, and rear cross slide. Total f.t.f. time, just 4¼ min.



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Madison 10, Wisconsin, U.S.A.

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Threading Lathes • Packaging Machines • Masterglas Molded Plastic Products

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SPOT NEWS...

- **The Air Force has ordered inspections of major contractors' plants.** The aim is to "survey management practices." Upshot could be a major overhaul of AF procurement policy, involving a tightening of control over pricing, subcontracting, cost estimating, and other contracting policies. Martin's Titan ICBM project will be the first program scrutinized.

- **Compressive strength of silicon carbide can be increased 30-fold** by subjecting it to 15,000 atmospheres pressure at 10,000 C, according to scientists at Brigham Young Univ. They've also made chromium and manganese oxides and zirconium and titanium borides with high compressive strengths, using relatively simple, high-temperature, moderate-pressure equipment.

- **British government has proposed setting up an international patent agency** through the Organization for European Economic Cooperation (OEEC). The agency would include machinery to eliminate the need for individuals to make separate patent applications in each OEEC country. At present, the Common Market group is attempting to set up a common patent system.

- **Corrosion resistance for metals used at temperatures from –60 to 2000 F** is provided by Cermet N16, a ceramic-like coating developed by the Columbus (Ohio) Division of North American Aviation. Coating also improves resistance to bending, torsion, thermal deterioration, and thermal shock failure. It is applicable to low-carbon steel, tool steel, cast steel, enameling iron, cast iron, copper, stainless, molybdenum, columbium, and tungsten. Seaporcel Metals, Long Island City, NY, is licensee.

- **Capital spending by the metalworking industry will hit $3.96 billion in 1961.** The total investment for new plants and equipment by American business as a whole will be $35.1 billion. First estimates of capital spending for 1962 are close to those for 1961. For full details see page 147.

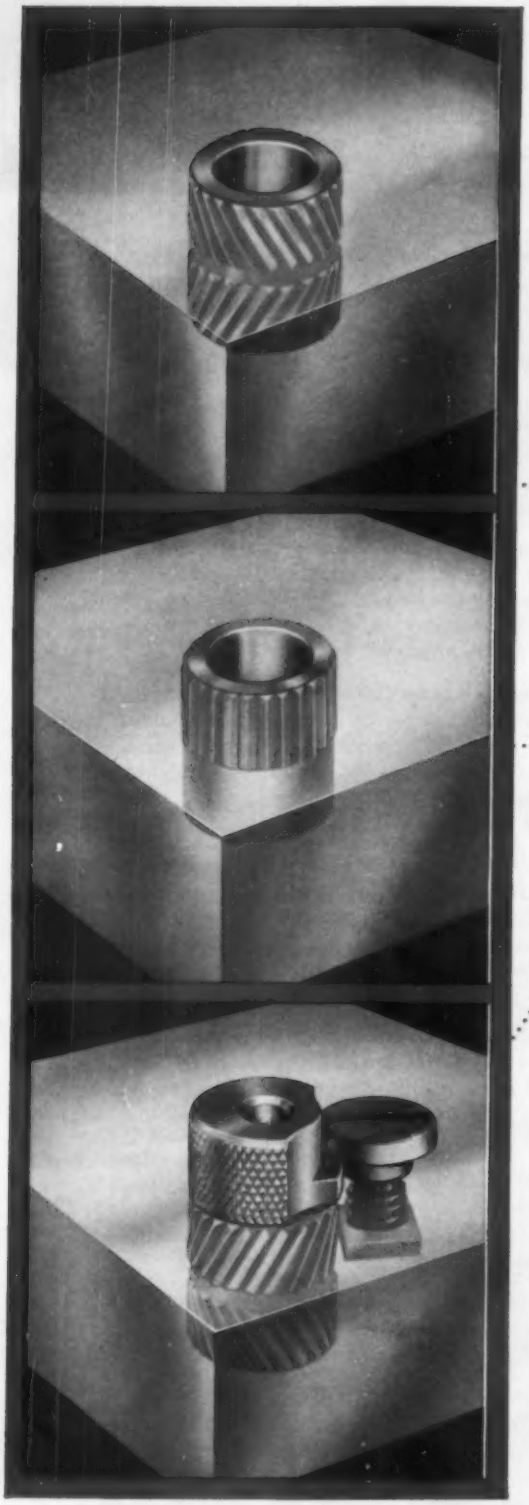
- **Addition of phosphorous can increase the strength of austenitic steels,** say Soviet metallurgists. Alloying with phosphorous (in fractional percentages) boosts the yield and stress-rupture characteristics of stainless steel. Addition of 0.3% phosphorous to nickel-bearing (7%-9%) steels is said to improve heat resistance.

- **First application of an aircraft jet engine to provide stationary power** is a power package combining a Pratt & Whitney J57 engine and a Cooper-Bessemer free turbine. This 10,500-hp combination will drive a compressor on Columbia Gulf Transmission Co's main natural-gas pipeline. Other applications are expected in the petroleum and petrochemical industries, in electrical power generation, and in marine applications. Other units range from 350 to 15,000 hp.

- **Tungsten can withstand 3000 F for 20 minutes** if it is covered with alternate layers of chromium, silicon, and rhodium, according to an Air Force study. The coating is even more effective if it is diffusion alloyed completely and its surface is bonded and melted.

- **Liquid metals and gases are being studied as lubricants for space vehicles.** The Air Force is looking into liquid potassium and liquid rubidium "with the objective of one-year, maintenance-free operation," says Col W A Anderson, chief of the Materials Central Office at Wright Air Development Division, Dayton, Ohio. Space lubricants must withstand temperatures up to 1500 F. Another possibility is a fuel that will double as a lubricant.

- **Mass production of machine tools in Britain has been rejected as impractical** by the British Machine Tool Advisory Council. It recommends greater emphasis on research and development, standardization of machine tooling areas, and increased use of electronic controls. See page 140.



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WASHINGTON...

The Kennedy administration . . .

The new administration will of course give its own twist to just about every policy involving the metalworking industries and the economy as a whole. No one expects any radical shake-ups—no sweeping over-haul akin to FDR's 100-days—despite the chit-chat along these lines in the newspapers.

But there will be changes. And the word from the President-elect's closest advisors is: Don't try to predict what Kennedy will do by looking back toward Harry Truman or Franklin Roosevelt.

The Kennedy view will be impressed on such key issues as defense spending and reorganization (see page 125), aid to depressed areas, depreciation allowances, labor legislation, minimum wage, stimulation of the economy, foreign trade and protection of domestic industries, and interest rates.

Here's a rundown . . .

Here are some of the programs and projects that will come to the top quickly:

Depreciation: Kennedy is in favor of more liberal depreciation of capital plant and equipment, and you can expect this as part of any tax program. The Treasury's survey of depreciation allowances (which has been side-tracked while Under-Secretary Fred Scribner was working as a top Nixon campaign strategist) will be equally useful to the Kennedy team that takes over the Treasury Department.

Protectionism and trade: No big fight will come next year. But Kennedy's aides say he could come up eventually with a broad range of programs to help US sales abroad, and to offset this, vigorous programs to help industries and communities hurt by foreign competition.

Minimum wage: Chances look much better for early passage of increase in minimum wage to at least $1.15, perhaps $1.25. Important issue: extending coverage to retail and service trades, particularly.

Depressed areas: Look for a couple hundred million dollars to be approved for loans to such areas as Scranton—Wilkes-Barre, Detroit, Lawrence, Evansville, Baton Rouge, Buffalo, and Beaumont—Port Arthur. The money will go for plants and retraining employees to man the machines in the new plants as they get into production. States would have to match the federal funds.

Two machine tool studies pending . .

Now pending at BDSA are two machine tool studies. Both stem from OCDM's plan to bolster the industry, and could affect future Washington policy for the industry.

The first is a survey of imports and exports—to show marketing practices of foreign companies selling in the US and to suggest means of boosting US exports. This is now bogged down by a bureaucratic dispute over the use of industry-supplied figures vs Census Bureau statistics. The agency's machine tool experts feel that the census figures contain extraneous data.

The second is Arthur D Little, Inc's, survey of why US metalworking plants fail to modernize production equipment at a faster tempo. First draft of the study has been made, but conclusions won't be ready for another week or so.

Official turnover . . .

The change in Washington administrations will obviously mean a major turnover among top officials who call the shots on decisions affecting the metalworking industries.

At OCDM, the agency which is still running the study on "how to strengthen" the machine tool industry, Director Leo Hoegh and Deputy Assistant Director (for production and materials) Russell Hughes are presidential appointees and will leave office.

William N Lawrence, a deputy to Hughes, and Howard Smith, chief of the equipment and components office, two OCDM careerists long intimate with industry affairs, will stay on.

At Commerce Department's BDSA, Administrator Wm A White is a presidential appointee, and is expected to go. The director of the agency's Metalworking Equipment Division, Philip A Bennett, is a career Civil Service man and will remain.

The Defense Department will have a wide-ranging shakeup among officials making key policy decisions. This will reach down to the Assistant Secretary of Defense for Supply & Logistics, Perkins McGuire, and the assistant service secretaries for materiel or logistics.

But the technical specialists in the Pentagon's upper echelon are career men. These include such men familiar with metalworking as R A Crist, director of production policy in McGuire's department and John H Williams, staff director for industrial production equipment, who reports to Crist.

DIFFERENT SIZED PARTS INTERMIXED AT RANDOM ARE PROCESSED AUTOMATICALLY ON SNYDER SPECIAL 56-STATION TRANSFER

Here's another big Snyder special "building-block" transfer with a bit of extra versatility.

Specifications called for one sequence of operations on a big aluminum transmission cover case for domestic use and a different sequence on a smaller cover for export.

Schedules set a production rate of about four domestic units to one export unit but, for production convenience, the machine had to accept these parts intermixed at random and run them through automatically.

So, Snyder Engineering designed a "collar" which bolts to the smaller piece, bringing it up to locating and clamping dimensions of the larger piece. Lugs on the collar and workpiece control appropriate switches which by-pass certain operations. Parts are automatically positioned in process.

Operations include drilling, reaming, boring, tapping, chamfering, spotfacing, center holing, end milling, probing, air gaging, pressing in rectangular plug, pressing in bushing and a couple of washing operations.

Production is 150 parts an hour at 100% efficiency. Any of the 20 segments can easily be converted for comparable operations on other parts and the number of segments can be increased or reduced at any time. Your inquiries are invited.

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DETROIT...

Production levels . . .

Auto making is settling down to a 140,000 unit a week pace that sees some plants on overtime, others shut down.

Chrysler, for example, closed three big plants —Dodge main, St. Louis and Dodge Truck— throughout Thanksgiving week, and, in addition, laid off 1900 workers from Dodge main and Plymouth assembly plants in Detroit and Newark, Delaware.

In the same mail, though, came a notice that Chrysler Corp passenger car sales for the first ten days of November were up 35% over the same period last year.

Two compacts, surprisingly enough, seem to be in serious sales difficulty. There is currently a 125-day supply of unsold Lancers in dealer hands, and Studebaker's Lark follows closely with a 105-day inventory. 45 days is considered to be a healthy cushion.

Atlanta, Georgia was hard hit in November. The B-O-P assembly plant in that city was closed by labor trouble, and Ford is taking a month out to integrate Falcon and Ford assembly lines.

Woes from Britain . . .

Reports of mounting doldrums in the British auto industry are being received with mixed emotions in Detroit. Automakers here are of course happy that foreign invasion has been turned back, but two of the Big Three have substantial investments in their British subsidiaries.

Some reports say that 70,000 British auto workers are on a short work week, primarily due to softening exports to the US nor is it likely that this picture will be improved when domestic-made minicars hit the streets next fall.

Captive imports . . .

Detroit automakers are openly restive over prior commitments to market captive imports in competition with their own campacts.

Lincoln-Mercury has already written off any plans to import the latest Taunus. The company now hopes only to sell the 4000 now in the US.

The English Ford will be continued, but you now must place a special order to get a Zephyr. Promotion programs for Opel and Vauxhall, GM's two captives, have been toned down considerably. Dealer attitude is: "We'll sell you one if you want one, but why?"

Chrysler, on the other hand, has reorganized its domestic Simca sales organization in what may be a last effort to get this make off the ground. The new goal, with a considerable budget behind it, is to sign up experienced foreign-car dealerships rather than rely on half-hearted representation by Valiant-oriented corporation dealers. Meanwhile, Simca sales in the US have dropped off 50%.

Personal business . . .

The self-righteous fanfare over extension of car warranties from three to twelve months and/or 12,000 miles turned out to be a first-class public relations bungle.

Word is leaking out that such a warranty had existed at a dealer level as far back as 1941. Under the name of "Company Policy" a car owner could squawk to his dealer at any time during the first year of ownership, that is, if he knew about it.

Knowledge now is small solace to many who have footed whopping repair bills on relatively new cars. The idea at the time was to allow the dealer to picture himself as a square shooter and a fine man to do business with by allowing a seemingly free repair. However, not all dealers bothered with this nicety and their tactics are now coming to roost at a corporate level.

Quality control . . .

Statistics compiled by the Automobile Manufacturer's Association show that auto makers have done remarkably well in quality control.

Back in 1925 the average car had a lifespan of 6½ years and traveled 25,750 miles before it reached the junkyard. Today the span has doubled and mileages of 125,000 are common.

Now the goal is to cut down minor failures within this adequate lifespan. Probability studies, however, point up some cold facts. For example, a car contains about 10,000 individual components. If each of these components are built to a reliability factor of 99.999%, the overall reliability of the machine will be only 91.20%. In other words, if every part could be built to this more-than-Ivory-pure standard, one car out of every ten could still be expected to give its owner some trouble.

Conversely, according to the tables, if the reliability of each component drops to 99.00%, 99 cars out of 100 will give trouble. The industry achievement falls somewhat closer to the first figure, but herein lies the reason why "lemons" have been and will continue to be made by every car maker—**Don MacDonald**

MORSE... CINCINNATI BICKFORD GIVE A SHOW OF STRENGTH

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AIRCRAFT and MISSILES... TRENDS

Election impact on industries . . .

For the aircraft and missile industries, the Kennedy presidential victory is expected to bring a marked increase in the volume of procurement and R&D contracting and, possibly, some changes in the way the military does business.

On the spending side, the President-elect has spoken about an increase of $2.5 billion to $3 billion over the current $41.5 billion military budget. But he's been vague as to whether this is to be a dramatic, one-shot increase in the budget, which will be leveled off in subsequent years; regular large incremental rises each year as proposed by such critics of Eisenhower defense policy as the Rockefeller Committee; or a long-range increase over the next couple of years.

Actually, Kennedy has not immersed himself in military program specifics. He has leaned heavily in his defense policy pronouncements to date on Senator Symington and Lyndon Johnson. His defense price tag, for example, was borrowed from Symington, who used the $2.5-billion to $3-billion figure earlier in the year to criticize Eisenhower's military appropriation request.

What Kennedy wants . . .

From Kennedy's general military statements and the views of his advisers, this much is clear: The new President wants to expand both the nuclear deterrent and limited war forces.

He has bought the Air Force's strategy of a "counter-force" deterrent. This means a need for an ever-growing nuclear strike force powerful enough to destroy the enemy's nuclear forces. This concept clashes with the Army-Navy view of a "minimum" or "finite" deterrent—a small retaliatory nuclear strike force geared mainly to knock out the enemy's cities.

Spelled out, the "counter-force" strategy would mean greater production of Air Force Minuteman missiles and the Navy's Polaris missiles and nuclear submarines; a continuous airborne B-52 bomber alert; a stress on construction of hardened, less vulnerable sites for land-based ICBMs; and development of new bomber aircraft on a crash basis.

Kennedy's plans are also expected to earmark more spending for so-called conventional forces to fight local, limited, or "brushfire", wars. The most critical requirements in this area: accelerated buying of jet troop-carrier and cargo planes, tactical missiles, combat vehicles, small arms, and battlefield communications equipment, and development of advanced weapons for ground forces.

Defense reorganization . . .

The new administration is also expected to push for reorganization leading to stronger unification of the military services. Kennedy's advisers think this could lead to "efficiency improvements" in procurement. They believe some $1 billion in savings could be squeezed out through organizational changes.

Many Kennedy defense advisers advocate a complete merger of the armed forces and establishment of a single chief of staff. But the new President is expected to be more moderate, mainly because of potential congressional opposition to extreme proposals.

The Kennedy camp has talked of reorganizing the Pentagon "on the basis of function." Presumably, this would mean downgrading, but not abolishing, the individual services. New unified "strategic," "tactical," "materiel," and R&D commands would be set up. Each made up of the Army, Navy, and Air Force components which have these missions.

If carried to its logical conclusion, this plan would result in more centralized control over procurement and R&D contracting. There would be considerably fewer military field agencies authorized to deal with industry and, inevitably, fewer firms invited to bid on negotiated-type contracts.

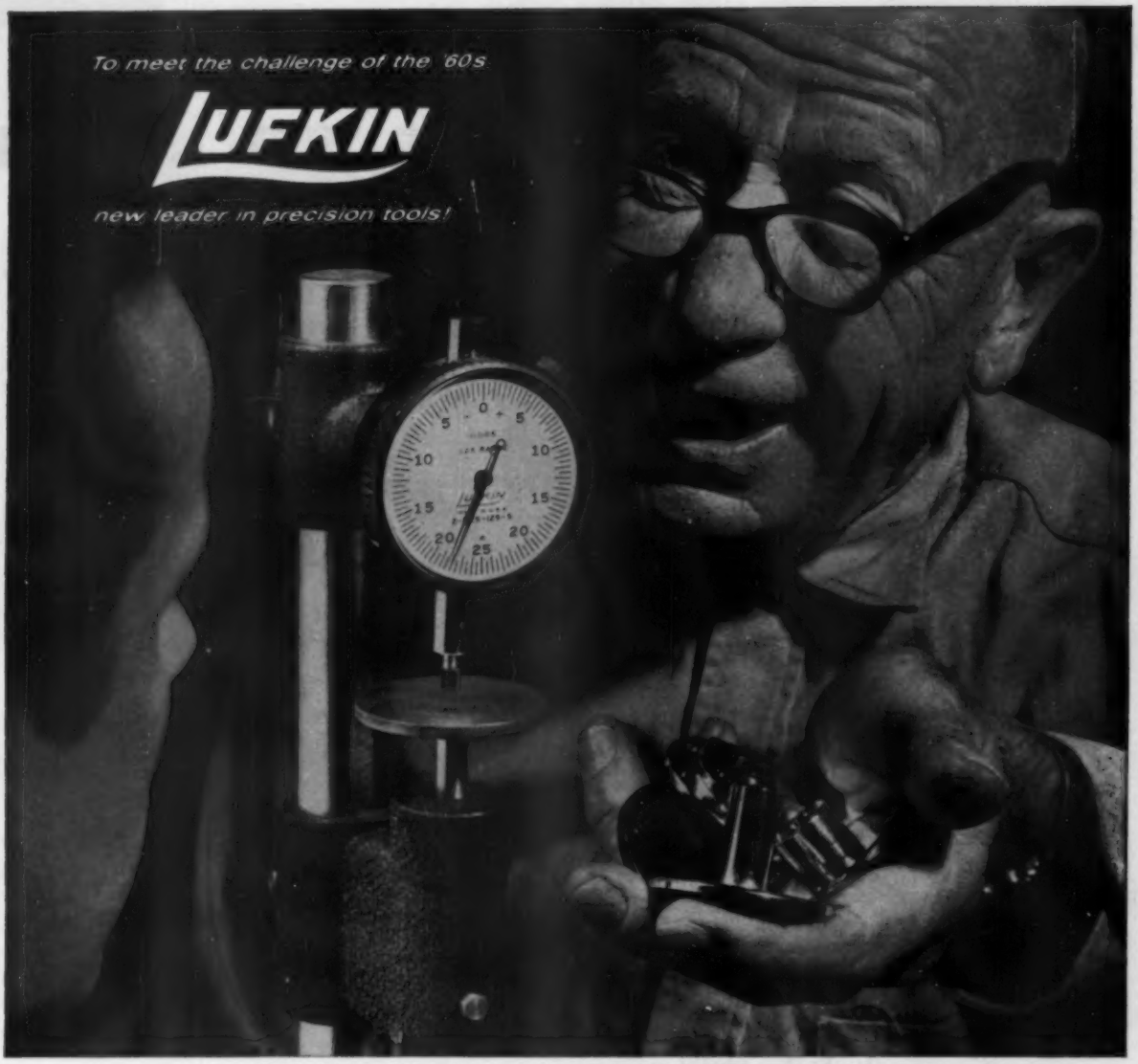
Overhaul for space . . .

An overhaul of the organizational setup for space operations also seems likely under the new administration. The bureaucratic separation of so-called "military" and "civilian" applications of space between the Defense Department and NASA is proving impractical and unwieldy.

This arrangement, in the view of many observers, has fostered duplication of effort and wasteful rivalries, has delayed important policy decisions, and has stymied long-range planning.

Many contractors gripe over the confusion on submission of project proposals. And Congressional leaders are peeved over the lack of central direction of the overall space program.

Vice-President-elect Lyndon Johnson, who has headed the Senate Space Committee, is known to have a special interest in the need for space agency reorganization.



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You'll seldom see them in the repair shop, because Lufkin dial-test indicators are made with one-piece forged-brass bodies. Movements are inserted from the top. So dirt *can't* get inside!

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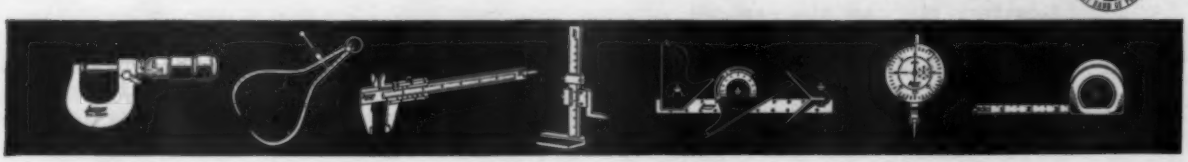
See your industrial distributor. He knows precision tools and can show you how Lufkin leads in design and craftsmanship. His stock is maintained to fit your needs. LUFKIN, Saginaw, Mich.



MACHINE TOOLS... TRENDS

Five builders get Soviet orders . . .

Five American machine tool builders have received orders totaling several million dollars from Soviet Russia, according to a Moscow announcement made by Stankoimport, Soviet agency handling exports and imports of machine tools.

Recipients of this business are: Ex-Cell-O Corp, Norton Co, Jones & Lamson Machine Co, Gleason Works and Bryant Chucking Grinder Co, which is an Ex-Cell-O subsidiary.

Cross Co is now negotiating with Soviet officials for an order for transfer machines, Stankoimport says. This deal, said to involve more than $5 million, has been pending many months.

The Russian orders are said to be for a V-8 aluminum engine for a light passenger car. Soviet authorities would like to die-cast the cylinder block. Two makers of big die-casting machines, one American and another an Italian, are reported competing for a Soviet order on this job.

Three of the five U S builders with Russian orders have been granted export licenses by Washington to ship their machines. The other two are believed to have license applications pending. There may be some delay in securing these added licenses, because lately Washington has suddenly tightened up its licensing policy.

A Russian truck engine tooling program also is attracting bids by U S builders, some of whom have been in Moscow recently.

Washington at the moment is taking a rather dim view of this project, which it is inclined to classify as military. It therefore is doubtful whether U S builders who might get orders for this program would be given clearance to ship machines.

B&S offers trade-in allowance . . .

Brown & Sharpe Mfg Co, Providence, R I, is offering a trade-in allowance of $500 for every old B&S automatic screw machine, regardless of age or condition. The allowance will apply to purchase of a new B&S automatic on the basis of one old for one new machine.

All old machines taken in trade will be returned to the company's main plant at Providence where they will be sent to the foundry cupola as scrap metal. The offer is effective immediately and applies only in the United States.

This trade-in allowance "will be the added stimulus needed to induce many owners to modernize the automatic screw machine section of their plants," according to Wallace B Bainton, vice president and general manager of B&S Machine Tool Division.

Mr Bainton says further, "We have long recognized the need for an active replacement program for obsolete high-production machine tools."

Almost 50% of the nation's single-spindle automatic screw machines now in use are from 10 to 20 years old, AM/MM's Inventory of Metalworking Production Equipment shows. In fact, B&S automatic screw machines up to 50 years old are still turning out parts, but with low efficiency. Brown & Sharpe's new program is designed specifically to make it easier to retire these obsolete units and replace them with new cost-reducing machines.

Permanent exposition advocated . . .

A permanent machine tool exposition that would be open the year round is being privately advocated by a prominent machine tool builder. This exposition would take the place of the every-five-year Machine Tool Exposition.

Chicago is the proposed site. A suitable exhibition building, convenient for out-of-town visitors, is reported to be available. Exhibits would be limited to U S builders so that the exposition would become, in effect, a non-stop national machine tool show.

The basic idea would be to have every builder install at the show his latest model just as soon as it is put on the market. The show thus would be an ever-changing exposition and, it is claimed, would attract buyers on a continuing basis from all over the country.

As a matter of record, the National Machine Tool Builders' Association already has very heavy contractual financial obligations covering the next two Machine Tool Expositions, in 1965 and 1970 in the Chicago Amphitheatre.

Press orders rise sharply . . .

Net new orders for cutting-type machines totaled $35.5 million in October, well down from $42 million in September. In the first 10 months of 1960 orders added up to $416 million.

Forming-type machines, as a welcome contrast, rose to $20.4 million during October, double the previous month's volume. This spurt was caused by a big Ford order. Machine tool orders and shipments charts are on page 139.

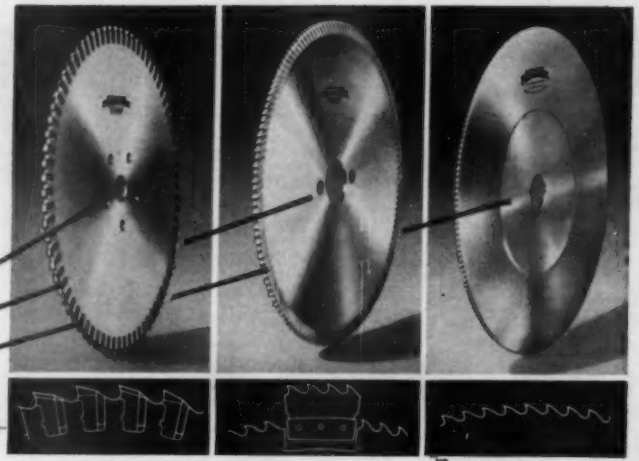
Do you cut ferrous metals? If so, Simonds has three basic saw designs for you:

INSERTED TOOTH METAL SAWS

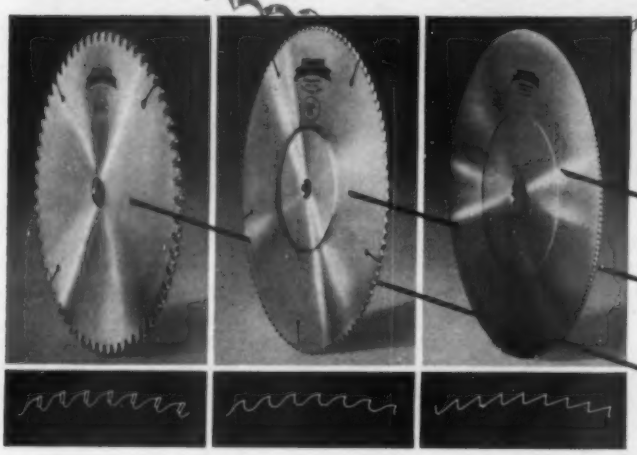
SEGMENTAL SAWS

SOLID TYPE SAWS

Available in High Speed and Semi-High Speed Steels



There's a SIMONDS Circular Saw Exactly Right for Your Metal Cutting Job



If you're cutting non-ferrous metals, Simonds offers you:

SOLID STEEL SAWS
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HIGH SPEED STEEL, HARD RIM SAWS
Hard cutting edge, soft center gives you long life coupled with safety.

CARBIDE TIPPED SAWS
for cutting aluminum and magnesium, as well as other non-ferrous metals

No matter what kind of metal you're working, there's a quality Simonds blade just right — a blade that means faster, cleaner cuts, longer blade life and maximum performance.

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TRENDS

MATERIALS...

Specs restrict foreign steel . . .

Birmingham, Alabama, is headquarters for Tennessee Coal and Iron Div of U S Steel—and the largest steel producing center in the South. In recent months, an estimated 9000 workers there have been laid off because of the slump in steel production. Real blame for these layoffs, say many people in Birmingham and other parts of the South, goes to what they call "The flood of low-cost imported steel."

Action taken early this month at a meeting, in Birmingham, of the Southern Building Code Congress resulted in a ban on the use of imported steel in construction subject to building-code regulations—unless the steel was "certified" by an American testing laboratory.

Construction in more than 900 southern cities and towns in 11 states comes under the jurisdiction of this building code. K M Clement, of Birmingham, a building-code engineer and director of the group explained, "The Southern Standard Building Code has specifications with which most foreign steel does not comply. We will enforce the code accordingly."

A blast from The American Institute of Imported Steel's president, A A Frank, called the ban a "blow against international trade." He said it would "tend to increase the cost of home construction to the detriment of the American family," and that this move was "a violation of the spirit and code of international obligations." He went on to warn that it could only result in retaliatory actions by "our friends and neighbors overseas."

"Buy American" is not a new slogan but it has seldom been enforced by technical specification. If this ban develops into a national trend, it could have a far reaching effect. While the short-term results might be beneficial, particularly in solving local employment problems, the long-range outcome holds considerable question.

Many prominent industrialists have said that we cannot survive in an international economy by restricting imports—even on a monetary basis by high tariffs. The only sound way to compete, they say, is to meet, or beat, competitive prices by productivity.

Perhaps one factor to be stressed in deciding for or against imported materials is how much value American labor adds to the material before it becomes a competitive product—and how much employment results from this added value.

For U S survival in international markets, the trend is toward selling technical skills, and products requiring complex technology, to a world of rapidly accelerating industrialization.

Light-steel casting standards . . .

For years, rigid radiographic standards of acceptance have guided both consumer and foundryman in their inspection of steel castings. But these standards are available only for sections in thicknesses of more than 0.75 in.

Improved casting techniques have resulted in increased use of casting sections thinner than 0.75 in. at critical structural locations. But no standards have been available for accepting or rejecting the structure of these castings.

Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland has contracted with American Brake Shoe Company's Research Center in Mahwah, N J, to prepare a set of standard radiographs for walls ranging from 0.13 to 0.75 in.

Defective castings 8 in. long by 6 in. wide will be produced by American Brake Shoe from these alloy compositions: 4130, 4140, 4330 or 4340, 347, 410 or 430, and 17-4 PH. Defects will include cold shuts, shrinkage, inclusions, cracks, gas holes, hot tears, and misruns. Basic plate thicknesses are ⅛ in., ⅜ in., and ¾ in. As many as 240 test castings may be made, to get the required number of standards. Final reference standards will be 2 in. by 2¾ in.

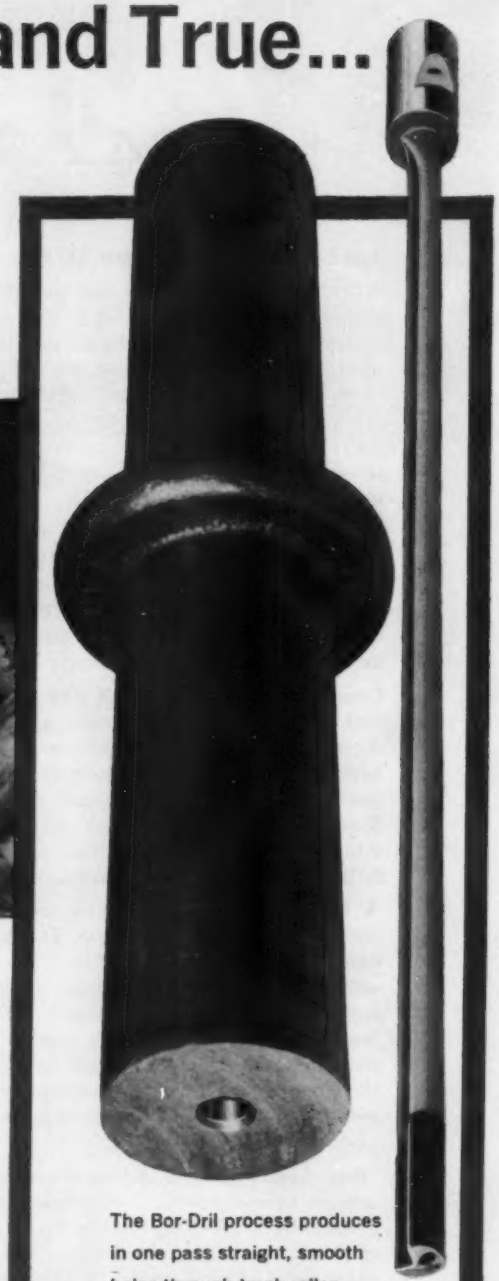
Only a single type of defect is permitted in each casting. Each radiographic illustration must clearly identify the flaw's shape and size. Most radiographs will be made to display the defect in several degrees of progessively increasing severity. Producing castings with designed defects is the most difficult task of this project.

Tinplate coil quality . . .

Tinplate bought in sheared-strip form could be sorted by the producer into primary and secondary grades by the producer on a sheet-by-sheet basis. Now that the trend is toward buying tinplate in coils, a severe problem of classification is created. However, Airborne Instrument Laboratory, a div of Cutler-Hammer, Deer Park, NY, believes it is helping to solve the problem with the installation of several automatic systems which sense the desired data from continuous lines running at 1600 fpm, accumulate the data, and present it as a typewritten record. Thus, control of the coil is provided during processing—and final condition is known for grading.

Deep Holes...Fast and True... with Ex-Cell-O

BOR-DRIL



The Bor-Dril process produces in one pass straight, smooth holes through track roller shafts 22½" long and weighing about 75 pounds each. Production is 20 pieces per hour on the two-station machine.

Drilling 11/16" diameter holes the full length of 22½"-long forgings posed a tough problem for production engineers who need the economy of volume output, the time-savings of one-step operations, and the performance of precision equipment. But they found the answer in Bor-Dril, Ex-Cell-O's process for gun-type drilling with standard production boring machines.

Measured in terms of production efficiency, the result is 20 pieces per hour, from an Ex-Cell-O Model 752 Precision Boring Machine set up for Bor-Drilling. Secondary operations are eliminated.

Bor-Dril can be applied easily and economically wherever you have long, small-diameter holes to produce to precision tolerances. See your Ex-Cell-O Representative, or submit your requirements direct to Ex-Cell-O for prompt analysis and cost estimate.

60-30

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

WHAT'S AHEAD... in Metalworking

TRENDS

Metalworking finishing year at high level...

Metalworking production is holding steady at 106 on the *AM/MM* Index, and is expected to remain at about that high level through November and December.

As was true last month, continued activity in Detroit has offset declines in other segments of the metalworking industry.

But the auto industry has pushed back some of its steel orders, and some steel spokesmen say that there may be additional cutbacks in steel orders from Detroit.

Farm implement buying of steel is on about the same level with steel orders from appliance builders. Heavy inventories coupled with a drop in demand are causing these manufacturers to hold back steel orders. Orders now are slower than they were a month ago.

Says one steel man, "I don't think there will be any pickup until the second quarter of 1961."

Inventory is the problem in the appliance field. Factory sales are down 20% for October and are running about 30-60 days behind retail sales, says a spokesman for the American Home Laundry Association. Production is on the rise now and most of the early layoffs have been rehired.

Small motor production continues slightly below 1959 levels. The industry as a whole is down about 8% this quarter. Off-the-cuff estimates are that 1961 will be about the same as 1960 or, at worst, down 4% to 5% from 1960. The smaller integral AC and DC motors are expected to take a sharper dip than the fractionals.

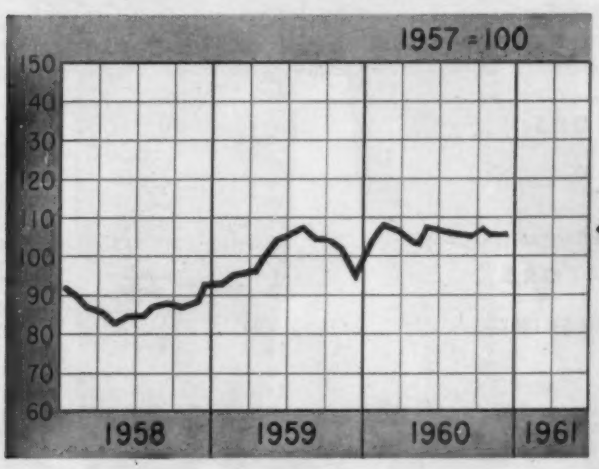
Shipments of materials handling equipment continue at a good rate, but bookings and inquiries are slowing down. January predictions of great strides in the industry have settled down to a year-end prediction of about the same results in 1960 as in 1959. Three spokesmen report that uncertain economic conditions seem to be holding back many sizable orders.

The continuing decline in tool and die orders has brought the NTDPMA five-year order curve to its lowest point. Orders for the latest month were 21% below the comparable period in 1959. The Association reports that the order slump is the fastest and most continuous drop that tool and die makers have experienced since 1957. The revised outlook for the year now calls for a 12%, rather than a 15%, gain over 1959.

Industrial fastener shipments rose eight points in the latest month, reports the Industrial Fastener Institute. The shipments index now stands at 97 (1956-58 = 100), the highest point since March of this year.

Capital spending by the metalworking industry will hit $3.96 billion in 1961, about 2% under the amount invested in new plants and equipment in 1960. The auto industry and the electrical machinery industry are planning to spend more in 1961 than they did in 1960; the other industries comprising metalworking plan cutbacks.

Spending in 1960 fell short of expectations. None of the metalworking industries spent as much as had been anticipated earlier in the year, and many of them have stretched out this year's spending plans into next. Full details on p147.

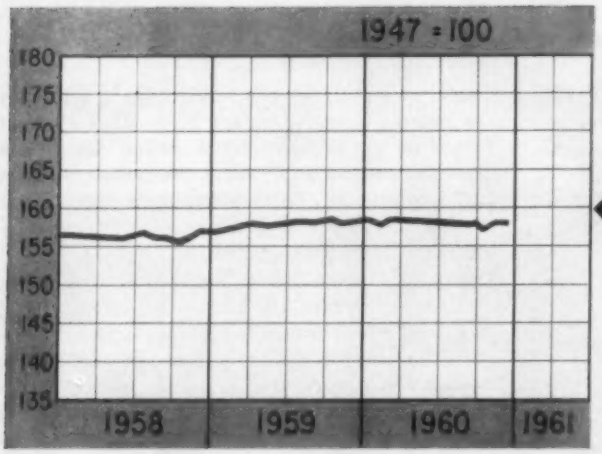


AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	NOV Estimated	OCT Preliminary	SEPT Revised	OCT Year Ago
Total Index	**106**	**106**	**107**	**103**
Machinery	103	106	103
Electrical Machinery	108	112	112
Autos	120	117	103
Other Transportation	90	89	91
Other Metalworking	109	109	104

TRENDS WHAT'S AHEAD... in Business



AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	NOV Estimated	OCT Preliminary	SEPT Revised	OCT Year Ago
Total Index	**159.6**	**159.4**	**158.2**	**159.5**
Metalworking Machinery	**193.3**	**193.3**	**188.6**	
Other Machinery exc. Electrical	**173.3**	**173.1**	**171.7**	
Electrical Machinery	**158.7**	**158.7**	**162.4**	
Fabricated Metal Products	**147.4**	**145.2**	**148.3**	

Government spending, a business plus . . .

Government spending, will be a powerful expanding force in the economy in 1961. Federal, state, and local government spending will rise by about $6 billion, coming to $105 billion for the year. This increase will more than offset cutbacks in spending anticipated for other sectors of the economy. And it supports forecasts of a generally good business year ahead.

Significantly, the projected increase is not an aftermath of the Presidential election. Expanded federal spending was charted well in advance of the campaign. And barring unforeseen developments, the Democratic administration is not likely to alter substantially outlays scheduled for 1961.

Beefed-up defense accounts for half the $3-billion addition expected for federal spending. Pay hikes to government workers and price-support payments to farmers are among other reasons for the increase.

But Washington won't be alone in jacking-up outlays next year. State and local governments will match the $3-billion federal increment with stepped-up expenditures on their levels. A bigger volume of public construction—roads, hospitals, public housing, for example—seems likely, as does higher spending for education.

Because government machinery moves slowly, these higher expenditures will materialize gradually, nudging rather than jolting the economy through 1961. But coupled with relatively high business capital investment, indicated by the McGraw-Hill survey of business spending planned for 1961, they paint a picture of solid economic strength (see page 147).

Mr Kennedy's administration will register its full economic impact only after programs to which he is committed—greater aid to schools, to urban renewal and to economically distressed areas—are implemented. Such programs are sure to stimulate business. But their effect on prices, on the U S balance of payments also is crucial.

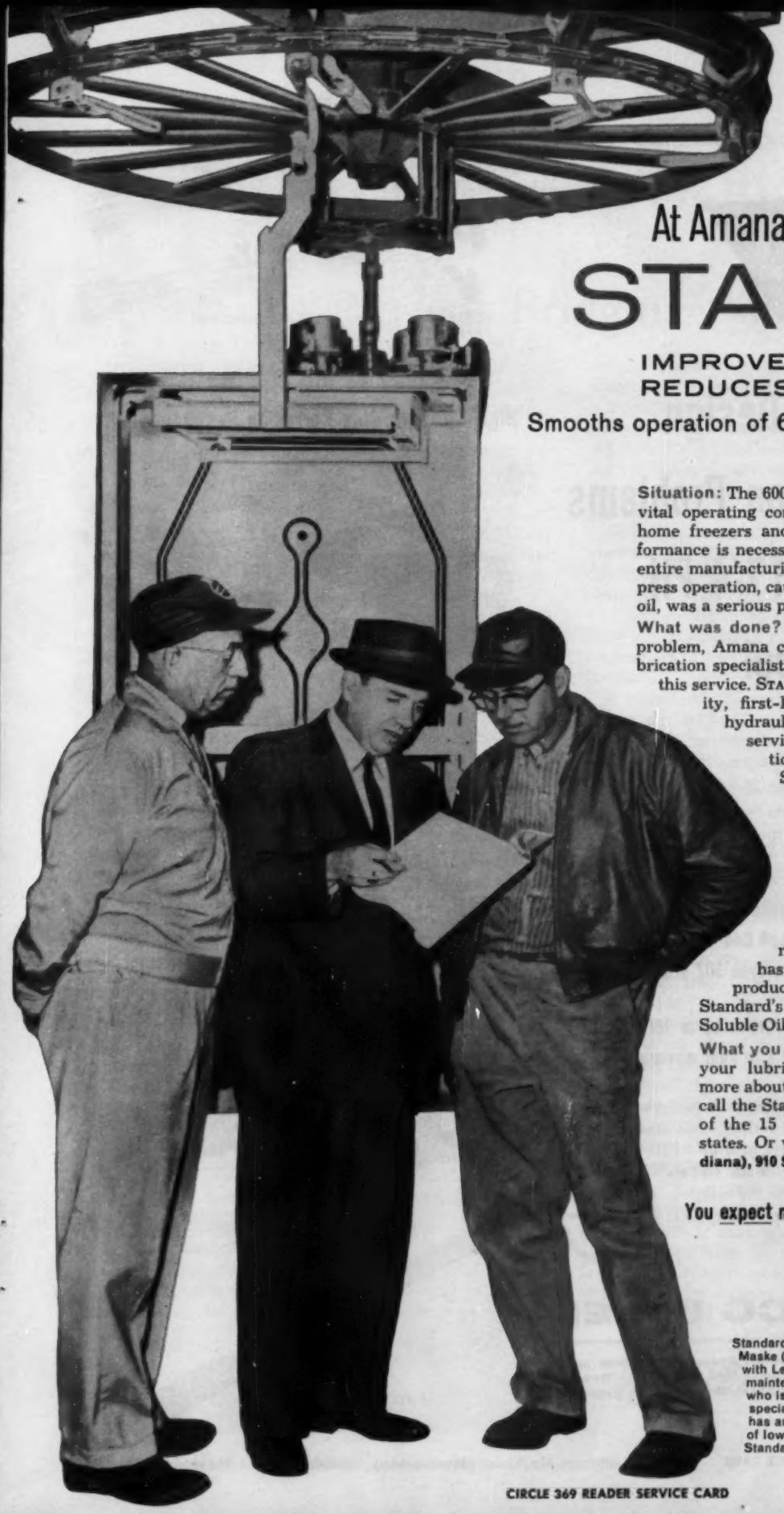
WEEKLY BUSINESS INDICATORS

	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	144.0	144.6	142.1
Steel ingot operation (thousands of tons)	1,464	1,468	2,233
Electric power output (million Kilowatt hours)	14,111	13,982	13,019
Production of automobiles	142,541	145,537	64,233
Engineering construction awards (Eng. News-Record—thousands	65,634	62,442	60,296

MONTHLY BUSINESS INDICATORS

	Latest Month	Preceding Month	Year Ago
Index of industrial production (1957=100)*	107	107	102
Index of durable manufactures production (1957=100)*	102	102	95
Durable goods manufacturers' sales, millions*	14,350	14,420	14,113
Machinery manufacturers, sales, millions*	4,710	4,700	4,663
Durable goods manufacturers' new orders, millions	14,680	14,410	14,747
Machinery manufacturers' new orders, millions	4,930	4,810	5,067
New Orders for Nonelectrical Machinery (1950=100)*	175	174	175
New Contracts for Industrial Construction (1950=100)	179	149	171

*Seasonally adjusted



At Amana Refrigeration, Inc.

STANOIL

IMPROVES PRODUCTION
REDUCES MAINTENANCE

Smooths operation of 600 ton hydraulic press

Situation: The 600 ton Verson Press at Amana is a vital operating component in the manufacture of home freezers and refrigerators. Its proper performance is necessary to the efficiency of Amana's entire manufacturing operation. That's why erratic press operation, caused by foaming of the hydraulic oil, was a serious problem.

What was done? In seeking the solution to this problem, Amana consulted their Standard Oil lubrication specialist who recommended STANOIL for this service. STANOIL Industrial Oil is a top quality, first-line industrial lubricating and hydraulic oil. It will provide excellent service in many different applications. And when tested by Amana, STANOIL proved perfect for use.

What has happened? Since STANOIL was first put to work at Amana, it has performed for extended periods of time without foaming or oxidation, lengthening the time between drainings and improving press operation. As a result of this record, STANOIL has been adopted for use on other production equipment, together with Standard's RYKON Greases and SUPERLA Soluble Oil.

What you can do: To get help in solving your lubrication problems and to learn more about STANOIL Industrial Oils, simply call the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.**

You expect more from STANDARD and you get it!

Standard's Jess Nelson (center) and Gene Maske (left) checking lubrication survey with Leonard Rettig, Amana's plant maintenance superintendent. Jess, who is District Engineer for Standard, is a specialist in this kind of operation. He has an engineering degree from the University of Iowa, and has also graduated from the Standard Oil Sales Engineering School.

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Use Armco 17-4 PH Stainless Steel to give *your* products new advantages. By replacing carbon steels, standard stainless grades or non-ferrous alloys with 17-4 PH, you can cut production costs and improve the life and reliability of vital parts. Write us for complete information. Armco Steel Corporation, 2350 Curtis Street, Middletown, Ohio.

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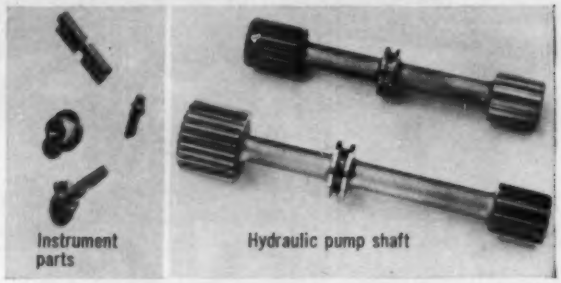
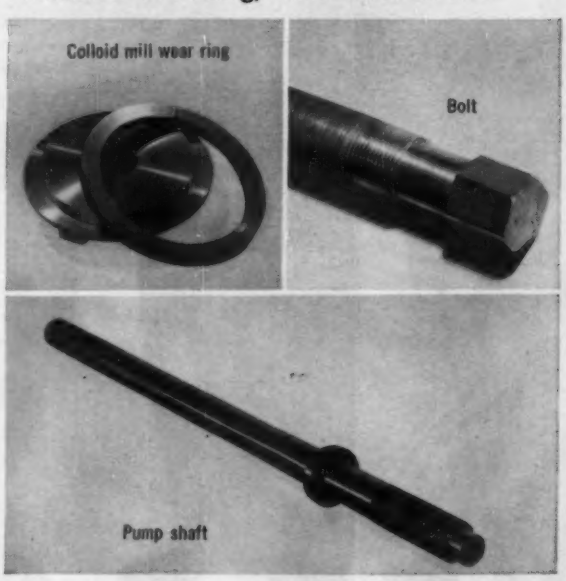
Elimination of Distortion and Scaling



High Strength Plus Corrosion Resistance

Resistance to Galling, Wear and Abrasion



American Machinist / Metalworking Manufacturing ESTABLISHED 1877

To Prevent Bridging the Gap

What a realistic, down-to-earth report on machine tools the subcommittee of the British Board of Trade's Machine Tool Advisory Council has made!

First it firmly disposes of the contention by Professor Seymour Melman of Columbia University that machine tools in the western world should be mass produced. While Russia is mass producing a few simple types of machines, it has what no nation outside the Communist bloc has —a huge captive market and a very large program for equipping new industrial areas.

Professor Melman admits that...

mass production of machine tools can be achieved in the West only by international centralization of demand, of standardization and of manufacture. Such a drastic proposal, the subcommittee says, is repugnant to democratic and sovereign nations.

Having rejected Professor Melman's main thesis, the subcommittee goes on to make some telling points, several of which are in complete agreement with his suggestions. And remember that the subcommittee is comprised of three prominent users, a labor unionist, and three government officials, as well as three machine tool builders.

The report deprecates the emphasis that Professor Melman puts on prices. It stresses that the decisive factor in investing in a new machine is its ability to reduce the cost of the product that it makes. Prices of machine tools are minor compared with other cost elements in manufacture. "To an ever-growing extent," the report reads, "production costs are reduced by use of high-performance machine tools in spite of their higher prices."

Don't get the idea that the user...

wants a reduction in the range of machine tool performance—horsepower, speeds, feeds, precision. The subcommittee bluntly states that users at home and abroad buy according to their needs. They are not forced to purchase performance or versatility that they consider uneconomic or nonessential.

In fact, if the British machine tool industry wishes to stagnate, the thing for it to do is to continue its present policy of building and selling relatively simple general-purpose machines, the subcommittee warns. That is why it is losing markets at home and abroad.

So the subcommittee recommends that British machine tool builders go in for research and development work on a scale never before attempted. For one thing, joint teams of machine tool and electronic system engineers should get busy on research projects. And development contracts will be placed by government departments.

A combined research institute and teaching center, similar to Germany's, is contemplated. A feature of the German institution is the interweaving of teaching and training with practical research on behalf of the German machine tool industry.

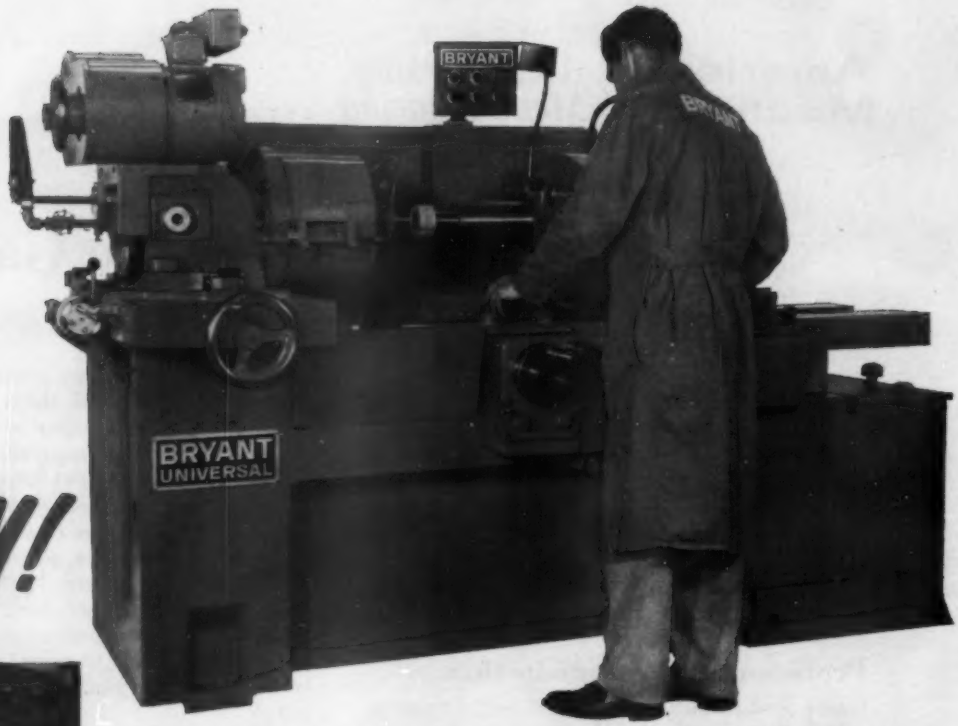
All of this should not go...

unheeded by our own machine tool industry. The Germans and the Swiss are engaged in offering buyers everywhere what they want—standard machines, high-production machines, and "specials." The British now have served notice that they intend to do the same thing. They will try to close the technical gap between their machines and ours.

So our job ahead is cut out for us. Our machine tool builders will not be able to be content with new designs every ten or five years. They must develop new designs constantly without letup.

Such continuing programs will be expensive. But it will not be a question of whether builders can afford them. It will instead be a matter of sheer survival, with Washington having an important stake in maintaining a healthy machine tool industry. With our much higher labor costs in building machine tools, it is absolutely essential that the critical gap of our technological superiority over others not be bridged.

Burnham Finney EDITOR



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For straight or tapered internal grinding!

For rotary ground flat surfaces!

For cylindrical or conically ground external diameters!

The BRYANT Universal Internal Grinder

A versatile machine that offers large machine capacity for internal, external and rotary face grinding.

The Bryant Universal performs a wide range of grinding operations and — what's more important — performs them quickly and economically.

The Bryant Universal is ideal for job shops or tool rooms where a single machine capable of handling a broad variety of workpart types and sizes is required. And it's accurate too: whether you are grinding to extremely close tolerances or doing routine production work, you'll find that the accuracy of size and finish obtained with the moderately priced Bryant Universal equals that of much higher priced machines.

Among the outstanding features of the Bryant Universal are:

COMPOUND CROSS SLIDE — Placement of the cross feed slide below the longitudinal traverse slide, results in sensitive, accurate slide control through reciprocation of a much lighter mass.

MULTIPLE WHEEL SPINDLE POSITIONS — Five longitudinal and two lateral positions for the wheel spindle combine with 15½" of cross slide travel, eliminating the need for a large selection of grinding spindles.

SWIVELING WORKHEAD — 90° pivoting of the workhead facilitates the grinding of tapers or rotary face grinding.

LARGE WORK CAPACITY — The Bryant Universal swings 12" dia. work within the chuck guard, up to 23" with the guard removed.

REVERSIBLE VARIABLE SPEED WORK DRIVE — Variable speeds from 150 to 750 R.P.M. provide optimum grinding conditions for all jobs.

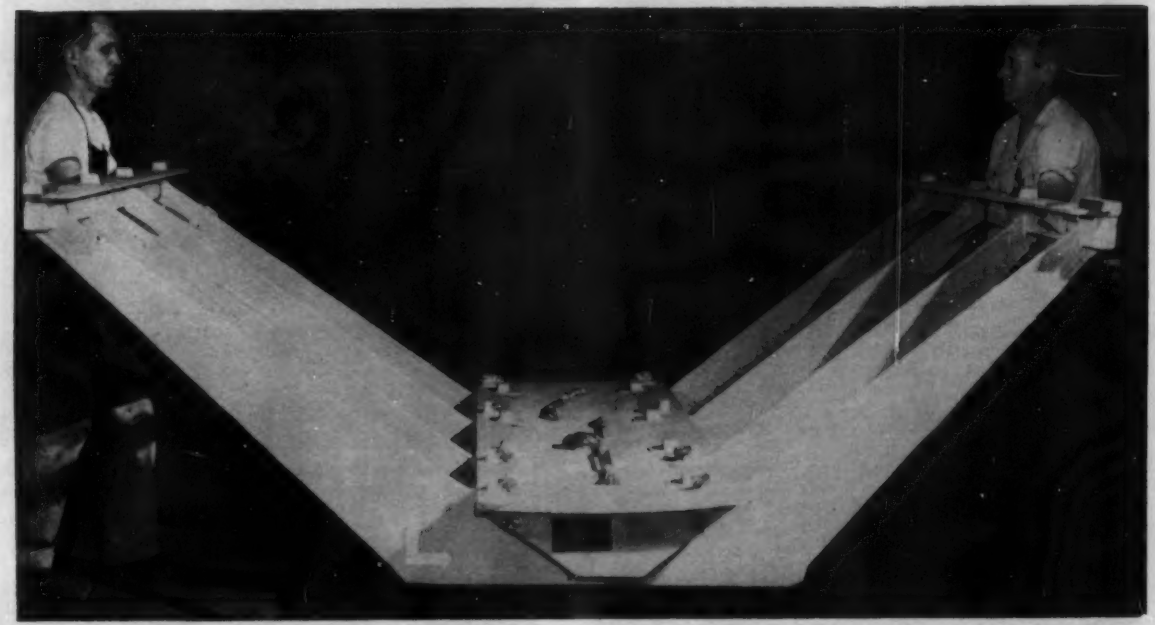
Contact your nearest Bryant or Ex-Cell-O sales representative, and let him show you how the Bryant Universal can make the production of varied workparts profitable for you.

BRYANT Chucking Grinder Co.

10 CLINTON STREET, SPRINGFIELD, VERMONT

Internal Grinders • Special Machinery

Scrap makes tools...



Honeycomb jig easily carried by two men is to position door hinges on both sides of the fuselage on B-52 missile bomber.

Structure is scrap aluminum honeycomb bonded with epoxy resin and faced with glass cloth

...when it's scrap honeycomb

Aluminum honeycomb bonded with glass cloth and epoxy makes strong, lightweight aircraft tools at a cost of only $1.98/sq ft of panel. Boeing's method of putting together pieces of honeycomb scrap from its production runs is the secret behind the low cost

By Waldo C Voth, general supervisor, tool design, Boeing Airplane Co, Wichita, Kansas

Platen press interlocks honeycomb sections with light pressure. Pieces may be trimmed square, then overlapped all around so they shear into each other

Honeycomb scrap from production runs on B-52 components is the basis for lightweight, inexpensive, but strong jigs, fixtures, and inspection tools at Boeing-Wichita. Simple presswork joins the pieces of scrap, then glass cloth and epoxy resin stiffen the mass and provide smooth outside surfaces.

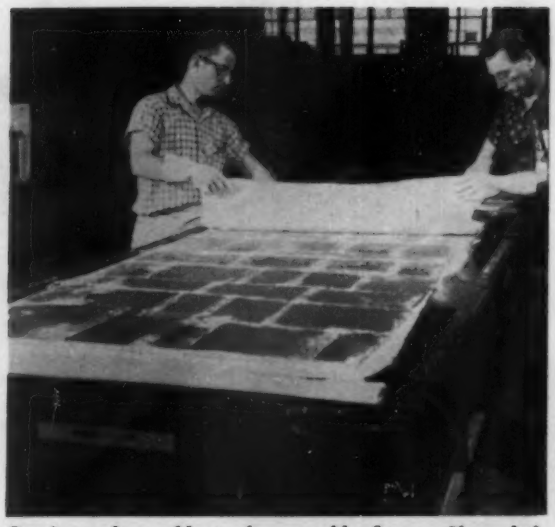
These tools-from-scrap have all the advantages of conventional laminated plastic tools, but are easier to handle, faster to make, and easier to store. There is less hand work with honeycomb panels, and tools are simpler to build.

Early plastic tools were solid glass-cloth laminates reinforced with heavy welded structures or filled with balsa wood, foam, or other materials that provided the necessary strength. These functioned satisfactorily, but they were heavy and expensive. Their application was restricted to complex contoured tools where the saving in hand work justified the more expensive tool materials and construction practice.

Aluminum honeycomb became a tooling material in 1953, when it solved a long-standing weight-vs-

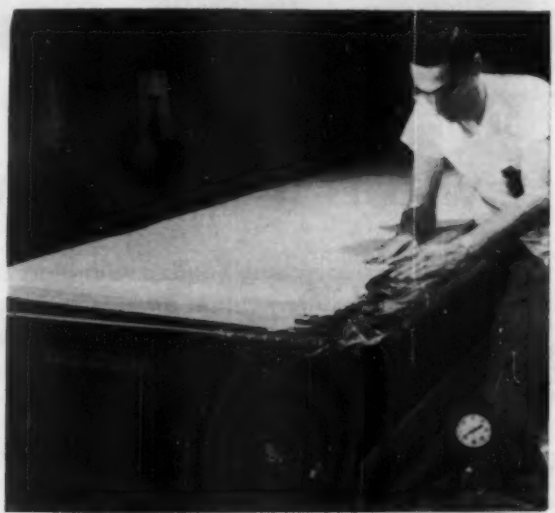
Scrap-honeycomb tools . . .

Honeycomb mosaic is all equal-thickness scrap, assembled into a panel 42 by 96 in. Light areas are sections where cells are sheared together so they interlock



Granite surface table is the assembly fixture. Glass cloth, honeycomb, and top layer of cloth lay flat. Cloth is resin-impregnated

Final resin coating wets down outside layer of cloth and forms flat, smooth surface on the sandwich. Epoxy resin is fresh-mixed for each sheet



Polyvinyl sheet goes over the assembly, held down at edges with zinc-chromate putty. Vacuum-pump connection is at near end of table. Air pressure holds the sandwich flat

stability problem in drill jigs for the B-47. But then, as now, standard honeycomb was too costly.

Scrap program

In 1956 Boeing started assembling panel cores from random segments of production scrap. The technique meant interlocking the edges of the honeycomb pieces in a platen press, then facing both surfaces with glass cloth and epoxy resin to form panels.

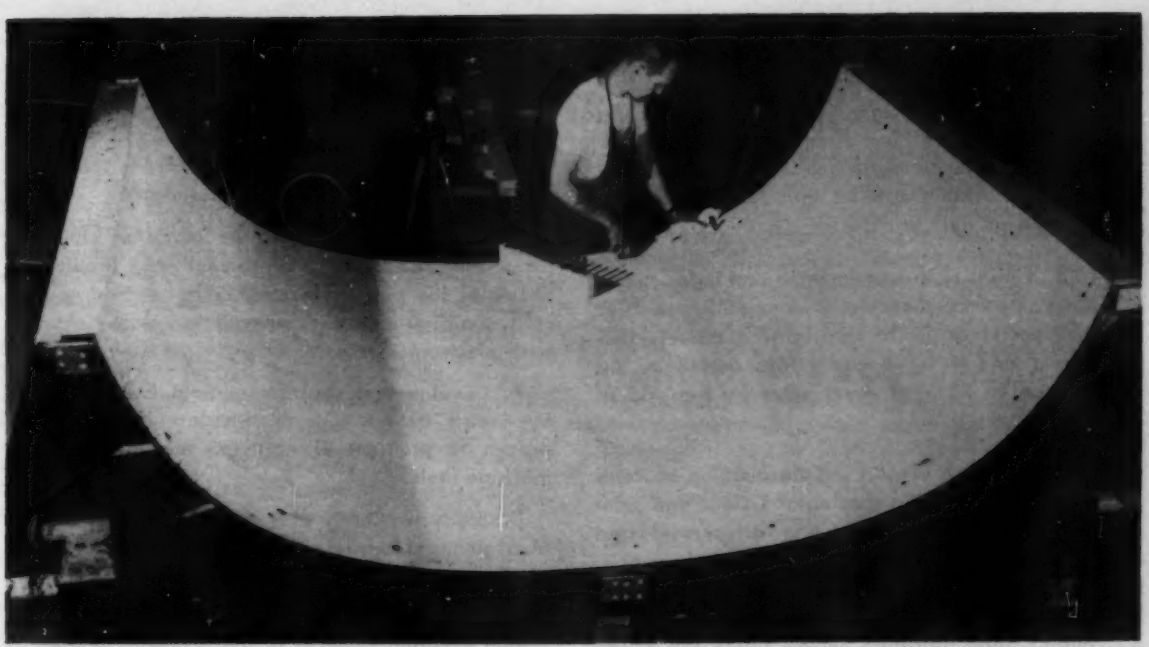
This produced an economical tooling material that has been further reduced in cost as bonding materials and technique have improved. Today the panels replace more conventional materials for a high percentage of the tooling applications in the plant —almost any job where weight is a factor. Typical tools; assembly jigs, router fixtures, and master gages.

The basic glass-reinforced honeycomb panel, like a solid glass-laminated panel, can be sawed, routed, filed, drilled, and sanded with standard woodworking tools. Sections are joined together or bonded to laminated epoxy sections, steel, or aluminum with epoxy resin. Drill plates are made by potting hardened steel guide bushings into position. The panel makes a good base for cast contoured layups, which can cover 100% of the panel.

Fabricating a panel

Four steps build a panel:

1. Like thicknesses of scrap aluminum honeycomb are salvaged from the production shop until enough are handy to make up one or more panels 42 in. wide and up to 96 in. long. Almost any size and shape of scrap can be included.



Master fuselage gage checks contours of three doors on the B-52. The honeycomb laminate can be sawed, filed, and sanded; wear pads or bushings can be inserted. Thin stock can be bent and formed

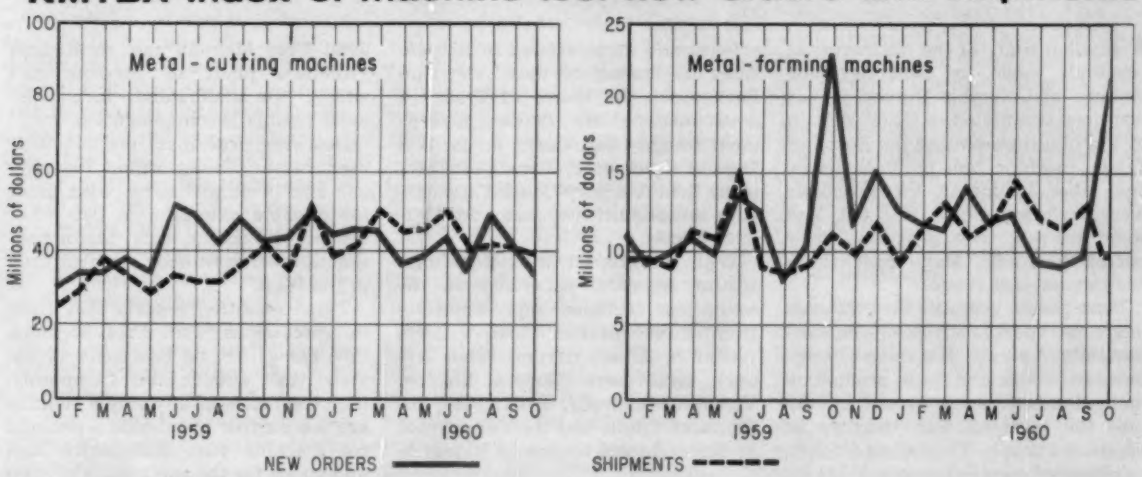
2. Sections are assembled like a mosaic, with each piece overlapping the edges of the next pieces by ½ in. The platen press closes slowly, creating a shearing, interlocking action under light pressure. The core assembly is joined mechanically.

3. Two or more layers of glass cloth impregnated with epoxy resin are spread on a granite surface plate, the honeycomb core is added, then two final layers of resin-impregnated cloth go on top. Resin is poured from a clean disposable container to impregnate the cloth layers as they are laid down.

4. Polyvinyl sheet is spread over the table, with edges secured by zinc-chromate putty. A vacuum connection is installed, and vacuum is pulled with a portable pump for 8 hours while the resin cures.

Finished panels are trimmed with a bandsaw and stored until needed.

NMTBA Index of machine tool new orders and shipments



Net new orders for metal-cutting machine tools dropped to $35,550,000 in October, down from $42,150,000 in September, according to preliminary figures from the National Machine Tool Builders Association. Domestic orders, however, rose from $25,800,000 to $26,050,000. The drop was entirely in foreign orders. Shipments in October were $39,750,000, down from $41,000,000 in September. Orders for metal-forming machine tools ran to $20,400,000 in October, up sharply from $10,150,000 in September. Here, again, domestic orders were up (by about $10 million), while foreign orders dropped. Shipments of forming equipment dropped to $9,950,000 in October, down from $12,950,000 in September

Major recommendations stemming from study of Melman Report by subcommittee of British Machine Tool Advisory Board:

1. Main recommendation that mass production of machine tools be introduced rapidly is rejected as not practical.

2. Future of British machine tool industry lies in technical excellence and more ability to meet the special needs of particular customers. Research and development effort should be increased to 10% of gross sales by the end of 1964.

3. Establish greater standardization of items (such as table sizes, spacing of T-slots, and spindle center heights) affecting attachment and location of tooling.

4. British manufacturers of unit head and multi-station machines should adopt the standards for modular units recently adopted by the American automobile industry.

5. Technical staff should be recruited to speed the process of formulating new standards.

6. Increasing use should be made of electronic controls. British machine tool firms should not enter the field of electronics but should recruit qualified engineers to maintain close links with electronic firms.

7. Development contracts should be placed by British Government to stimulate basic approach to problem of applying electronics to machine tools.

8. Study feasibility of a market survey of the likely demand for machine tools for 5 to 10 years ahead.

9. Investigate the age of machine tools in the United Kingdom (similar to the inventory made in the U S by *American Machinist/Metalworking Manufacturing*).

Emphasize RESEARCH, ELECTRONICS, STANDARDIZATION and SPECIAL MACHINES says report on British machine tools in rejecting mass production

A detailed study of the controversial proposals made by Prof Seymour Melman of Columbia University has just been completed in Great Britain by a group representing the Board of Trade, machine tool builders, users, and labor. Some of the proposals were endorsed, some rejected, and some entirely new proposals grew out of the study. Major conclusions are summarized above.

More than a year ago Prof Melman made his report to the European Productivity Agency. His main recommendation was that mass production methods must be introduced rapidly into the machine tool industry of Western Europe. To implement this, he proposed specific investigations into design problems, performance, production methods, and markets.

Although Prof Melman's report has not been published by EPA, his views have been made known through speeches and newspaper articles and on television in Britain. After discussion of these views in Parliament, the Board of Trade (a department of the British government roughly equivalent to the U S Dept of Commerce) through its machine Tool Advisory Council appointed a subcommittee to study the Melman Report.

With Sir Steuart Mitchell, Ministry of Aviation, as chairman, the committee included representatives from three machine tool builders (Asquith, Albert Herbert, Thos Ryder), three users (General Electric, Vickers Armstrong, Jos Lucas), the Board of Trade, and the Department of Scientific and Industrial Research.

Mass production

"In our view," says the new report, "true mass production refers to production lines specially set up for continuous production of one specific product for long periods. This is what Prof Melman saw in Krasnii Proletarii plant in Moscow and which, we understand, forms the basis for his recommendation."

However, true mass production is used in the Soviet Union for only one size of engine lathe, with plans for possible extension to two other designs of machine tools. Major portion of the output is by methods used in the West.

The committee reports that from its discussions with Prof Melman, "we know . . . he has come to the view that outside the Communist *bloc* the limits of any single country are too narrow to provide a demand for machine tools sufficiently high and stable for the application of mass production techniques."

There is no likelihood of such far-reaching international planning in the foreseeable future, says the committee, and "we do not regard the extreme regimentation and control

necessary to create these conditions as being acceptable to democratic and sovereign countries."

In addition, the committee says Prof Melman overstresses the price of machine tools. The price of the machine tool is only one element of manufacturing cost. The committee studied typical large jobbing factories and found that a 25% reduction in machine tool prices would represent of itself only between 1 and 2% of total production costs.

"To an ever growing extent overall production costs are *reduced* by the use of high performance machine tools in spite of their higher price," says the committee. "We do not consider that any reduction in price resulting from mass production would generate the necessary increase in demand."

Mass production implies standard and general purpose designs. "The clear trend in the more highly industrialized countries is for the concentration of production in the machine tool *using* industries into larger production units." This results in a growing demand for complex, high performance, specialized machine tools that are the antithesis of the mass produced machine tool.

In thus rejecting Prof Melman's main proposal, the committee agreed that "important advantages are obtained when manufacture is carried out in large production units" and that there is room for progress in this direction in "some sectors of the United Kingdom industry."

Urge more research

One section of the British study deals with matters that were not specifically mentioned in the Melman Report but are closely connected with its contents. Of these, the committee considered more research and development most urgent.

Only 1.3% of the employees of British machine tool firms are engineers and scientists, and only 0.29% are in research and development. In 1958, 90 machine tool firms employing 30,000 people had a total of only 25 graduate engineers.

Increased research and development, stresses the report, should be directed towards:

- Machine tools incorporating new techniques, especially new control techniques.
- Machine tools combining functions now normally performed on several machines.
- Machine tools capable of producing work to finer tolerances.

A combined research and teaching center is proposed, on the lines of the Technische Hochschule in Aachen. "The outstanding feature of the specialist courses on machine tools is that teaching and training are interwoven with practical research which is undertaken on behalf of the German machine tool industry."

The bulk of the research, however, must be conducted by private firms. "We warmly welcome," says the report, "the intention of the Dept of Scientific and Industrial Research to place contracts for the development of machine tools."

The British machine tool industry now spends about $8.4 million a year on research, and this should be increased to 10% of gross sales by the end of 1964, says the report. This would amount to about $22 million a year.

There is an urgent need for more research of a fundamental character, and about 20% of the increase should be in this area. This work, says the committee, may well be highly speculative and "can properly be regarded as qualifying for assistance from public funds."

Need for standardization

The manufacture of components has already been standardized to a considerable extent, says the report, and there is little likelihood of any major advance.

However, the standardization of parts of machines of primary importance to users should receive more attention. These include uniformity of table sizes and spacing of T-slots on milling machines, more standardization of spindle center heights on certain types of boring machines, and toolholder attachments and jig and fixture attachments of all kinds. The committee recommends that the machine tool industry establish greater standardization in these areas, acting in close consultation with users and the British Standards Institution.

As for Prof Melman's proposals on modular units, the committee agrees that the widest practical use should be made of modular units.

Unit heads, columns, bases, tables, and platens for straight-line, index, and drum-type machines are in fairly common practice. The use of modular units for such machines is widely known and no special investigations are considered necessary.

Greater standardization of details used for assembly and location of unit heads is desirable. The report states: "We believe that the standards now accepted by the American automobile industry, based on the Ford Motor Company's work, could well be adopted as international standards and that to promote this objective the United Kingdom machine tool industry should adopt them as soon as possible."

On the other hand, the committee does not approve of the idea of using one unit for a number of different basic operations—as would be the case if the same spindle were used in an engine lathe, a milling machine, and a boring machine. To construct standard machines from such units would prejudice the design of a functionally satisfactory machine.

Prof Melman called for an inquiry into how the process of establishing standards could be simplified and speeded up. The committee agreed with this and suggested that the benefits to industry generally of greater standardization are sufficient to justify the cost of a staff adequate for the purpose.

Electronic controls

Few British machine tool builders are equipped to explore the techniques of machine tool design for use with electronic controls. The committee urges a substantial increase in development effort.

Greater awareness is needed of the growing importance of electronic and control system engineering techniques, not only for control of machines but also for built-in inspection facilities and for integration into systems employing electronic design data processing.

The necessary dovetailing of mahandled case by case by an association between the machine tool builder and an experienced electronics firm. The committee does not recommend that machine tool companies become builders of electronic control equipment, but suggests that they should have electronic engineers on their staffs to form a link in a joint activity.

Other proposals

In other areas, the report summarizes some of the marketing problems of machine tools and endorses the idea of long-range market research, reports the increase of facilities for leasing, states that holding stocks of machines during periods of reduced demand can only be used to a limited extent, and urges an investigation into the age of machine tools currently being operated in the United Kingdom similar to the *AM/MM* Inventory that is "a traditional feature in the United States."

Match grinder is automatic. Operator places part between centers and presses button. Operation is controlled by Grind-A-Mate (right). Barrel is master and plunger is ground to match it. Total allowable tolerance spread is 0.000,080 in.

Match grinding to millionths in minutes

Rejects are under 5% as this specially fitted grinder turns out parts precise within 0.000,080 in. in production.

By William M Stocker, Jr, senior associate editor

Match grinding offers one reliable method of achieving the extremely close tolerances, in production, now required in an increasing number of mechanisms. Matching to millionths is practical where measuring to millionths still creates doubt.

Matching can be done in terms of a mating part or to a master plug. Matching may insult the skilled machinist who believes he can measure to millionths just as readily—but the cost of his pride in time and rejects can be high.

Typical of the kind of part suited to match grinding is the plunger-and-barrel assembly, which is the heart of the precise diesel-engine fuel pump. At the American Bosch Division, in Springfield, Mass, of American Bosch Arma Corp, the second, third, fourth, and fifth match grinders built by Cincinnati Milling Machine Co produce these parts.

The barrel-and-plunger assembly is made from 52100 alloy steel, especially stabilized by tempering and freezing for several cycles. Total tolerance spread for these parts is 0.000,080 in. Working as a booster pump to supply precisely metered fuel to the diesel injectors, the injection pump operates at 7000 psi pressure. Its volume is 100 to 150 cu mm per stroke, depending upon whether the engine is normally aspirated or is supercharged.

Prior to the match grinding operation, the barrel is gun drilled, honed, and lapped on the line. Taper, out-of-round, and bow are held within 0.000,080 in. Bore size is held within 0.000,16 in. and surface finish is a maximum of 3 mu-in. rms. Then 24 hours before the match grinding is done, the barrels are placed in the air-conditioned room where matching will take place. The room is held at 76 F ± 1°.

Semi-finish grinding on the line prepares the plunger. It is held to 0.0002 in. for size and 0.0001 in. for taper and roundness, with no special maximum for surface finish. This operation is done on Cincinnati center-type grinders and the plungers also are held in the air-conditioned room for 24 hours prior to matching.

For matching, the special grinder is automatically started three hours ahead of the shift starting time by a timer on the wall of the room. The machine grinds the OD of the plunger to match the ID of the barrel. Specifications call for the plunger to be round within 0.000,030 in. The grinder consistently holds roundness within 0.000,010 in. Plunger *diameter* calls out a maximum spread of 0.000,060 in. per piece, but the machine must find the actual size of each piece.

Match grinding is done with an 80-L wheel, which consistently holds a 2.5 mu-in. finish with no sign of burnishing.

A finer wheel produces a better finish but loses roundness. Coolant is a mixture of Cimcool and soluble oil, blended to give the desired surface finish. Its temperature is held within ±2° and preferably 2° above room temperature.

Pump motors, for coolant and hydraulic fluid, are in a separate package from the match grinder structure, to avoid heat distortion and vibration.

Originally, these parts were matched by hand-lapping. A rejection rate of 20% was standard for this operation. Today, the rejection rate for match grinding is under 5%. Floor-to-floor time is 2 minutes. Because of the close operating control and attention, the percentage of machine downtime is well under the average for line equipment.

Edwin A Nichols, section supervisor, cost estimating and advanced processes, who gave us details on this installation at American Bosch, says this exceptional capability is a product of machine-tool construction and fitting. Grinding is done between

centers and, for example, even the work driving dog is balanced, with its drive arm moved out from the center to minimize force.

Taper control, by a Federal Products Gage-Line instrument, is placed at the heavy end of the table (left), where it provides more sensitive control, rather than at the right.

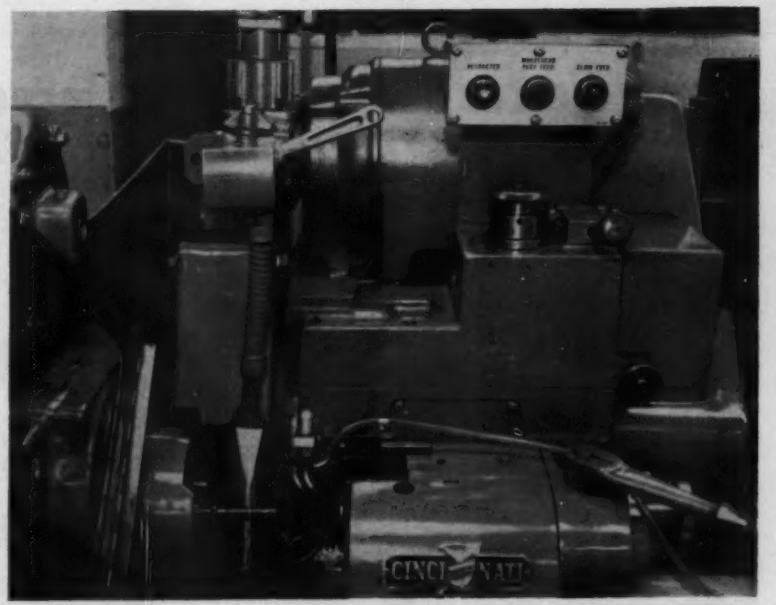
Actual matching is accomplished by the Cincinnati Grind-A-Mate which controls the machine by comparing (via air gages) the inside diameter of the barrel, the outside diameter of the plunger being ground, and a preset clearance factor.

Lights on the instrument indicate which phase of each complete cycle is in progress, and similar lamps on the grinder provide the same information. The complete cycle consists of rapid advance, fast feed, slow feed, and a dwell period to stabilize the spring in the piece. Clearance between the barrel and the piston diameters is constantly computed and the wheel retracts when this value reaches the amount preset for the assembly.

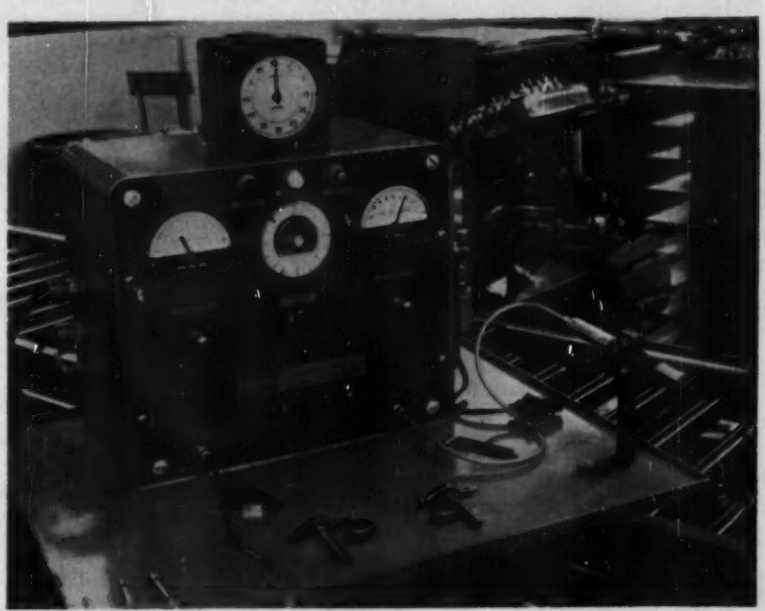
Thermal treatment of the 52100 alloy, according to Robert Libsch, chief metallurgist, is essential for stability. The alloy is purchased in the spherodized condition; leaded when possible. Spending about ¾¢ per lb for leading saves cutting tools, increases machining rate, and gives a better finish. Lead does not appear to affect the accuracy.

The material is stress relieved, after rough machining, at 1150 F for two hours minimum at heat. It is hardened in controlled atmosphere, quenched in atmosphere, and then immediately deep-frozen at –120 F. Then the 52100 is double tempered at 350 F. After each rough grinding operation it is retempered at 350 F. Deep freezing eliminates any retained austenite.

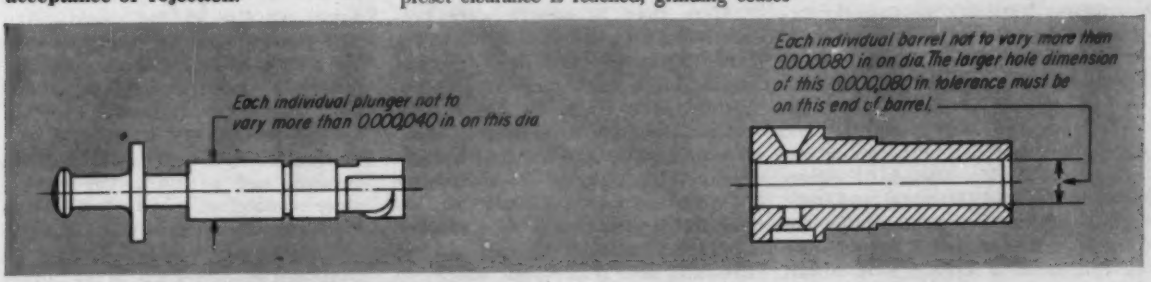
In spite of the close control of both the material and the process for this critical assembly, dimensional checking is not sufficient. A test stand measures fluid pressure and volume, and leakage, as the final criteria for acceptance or rejection.



Air gage checks ground diameter; provides data to control instrument. Coolant is mixture of Cimcool and soluble oil, for surface finish under 3 mu-in. rms



Control instrument compares barrel ID and plunger OD to compute clearance. When preset clearance is reached, grinding ceases


Each individual plunger not to vary more than 0.000,040 in. on this dia
Each individual barrel not to vary more than 0.000,080 in. on dia. The larger hole dimension of this 0.000,080 in. tolerance must be on this end of barrel.

Barrel and plunger dimensional tolerance typifies growing demand on metalworking

First Die Casting Show:

More die-cast auto engines forecast

Auto engines will gradually switch from gray cast iron to aluminum, and future aluminum engines will undoubtedly be made by die casting, according to A F Bauer, assistant general manager and chief engineer at Doehler-Jarvis division of National Lead Co. "This technique," he says, "has the edge over other casting methods because it eliminates sand cores and provides higher production rates. Die casting costs will go down as better die steels are developed and as engines are designed specifically for the process rather than the other way around."

Doehler-Jarvis produces the six-cylinder die-cast aluminum engine blocks used by American Motors (*AM/MM*—Oct 3 '60, p123). To date, more than 50,000 of these blocks have been cast on four 2000-ton machines at the Doehler-Jarvis plant in Toledo, Ohio.

Sectional dies reduce upkeep

Discussing die life in producing the AMC blocks, Mr Bauer points out that the main body of the die is good for more than 500,000 or even 1-million pieces, but that certain sections of the die may need replacing after 80,000 or 90,000 pieces. These critical areas, subjected to excessive thermal stresses, are of sectional construction to simplify replacement. Such a sectional die costs about $170,000, but the parts that must be replaced represent less than one-half the total cost. So upkeep is not a major problem. In the future this cost of upkeep may be reduced further through use of aluminum alloys with only a 50° F lower melting point.

The head on the AMC engine is currently made of cast iron because of casting problems, but it will be die-cast aluminum when current development work is completed, noted Mr Bauer in his discussion at the recent First National Die Casting Exposition and Congress in Detroit.

Sponsored by the Society of Die Casting Engineers, the four-day show and its technical sessions drew approximately 10,000 engineers and production men, including many visitors from Japan, Canada, Sweden, France, England, Germany, and Italy.

Interest in die-cast aluminum engines is not confined to this country. G Triulzi of A Triulzi S A, Milan, Italy, disclosed that his firm is now building a 2500-ton machine for producing a die-cast aluminum block (similar to AMC's) in Russia. And Hiram Barton of Hiram Barton Associates, Ltd, England, pointed out that British and European interest in die-cast engines is increasing.

Exhibitors at the show totaled over 100 and included die casters, die-casting machine builders, builders of production and finishing equipment, producers of die steels and casting metals, and many companies servicing the die-casting industry.

"Microcrazing" eliminates cracks

A new die-making technique was demonstrated by Shaw Process Development Corp, a division of British Industries Corp. The process, involving a ceramic-mold precision metal casting, was applied to a die for making aluminum auto horns to show the phenomenon of "microcrazing," which produces minute fissures or air gaps through which gas and air can escape. This eliminates porosity, cracks, surface inclusions, and other possible defects that can occur in casting.

Other outstanding exhibits included a new Kux automatic hot-chamber die-casting machine capable of a 4-second cycle with a 10-in. die movement and a 6-in. metal injection stroke. Cleveland Automatic Machine Co introduced its new Model 100 die-casting machine, available as a standard or a fully automated hot-chamber or cold-chamber unit. HPM Division of Koehring Co showed one of its line of 100- to 2000-ton Cast-Master machines, and Reed-Prentice Division of Package Machinery Co demonstrated an automatic vacuum-feed system that combines vacuum die casting of aluminum with automatic loading.

Technical papers

More than 30 papers were presented at eight technical sessions, covering such topics as die design, die building, metallurgical developments, competition to die casting, cost and profit, quality control, vacuum die casting, and the future of die casting. Its future in the automotive field alone appears quite bright; engineers expect to see more die-cast aluminum blocks, die-cast wheels, firewalls, door frames, and other major structural members.

In discussing die design, John Caster, of the research staff at Syracuse University Research Foundation, described a mathematical method of analyzing design problems. Metal flow considerations in die design are taken into account; formulas relate the porosity level of die castings to measurable variables, including gate areas.

Increased cooperation between product designers and die casters will stimulate more and more automation in die casting, according to Lee S Garretson and Tom E Nadeau, both of Ford Motor Co. Competition to die casting includes rigid plastics, said Wm O Bracken, Hercules Powder Co, and also includes sand casting in many respects, according to Thomas Pfaff of Pontiac Motor Division of GMC. Mr Pfaff described technological improvements in sand casting that tend to close the gap existing between these two casting methods.

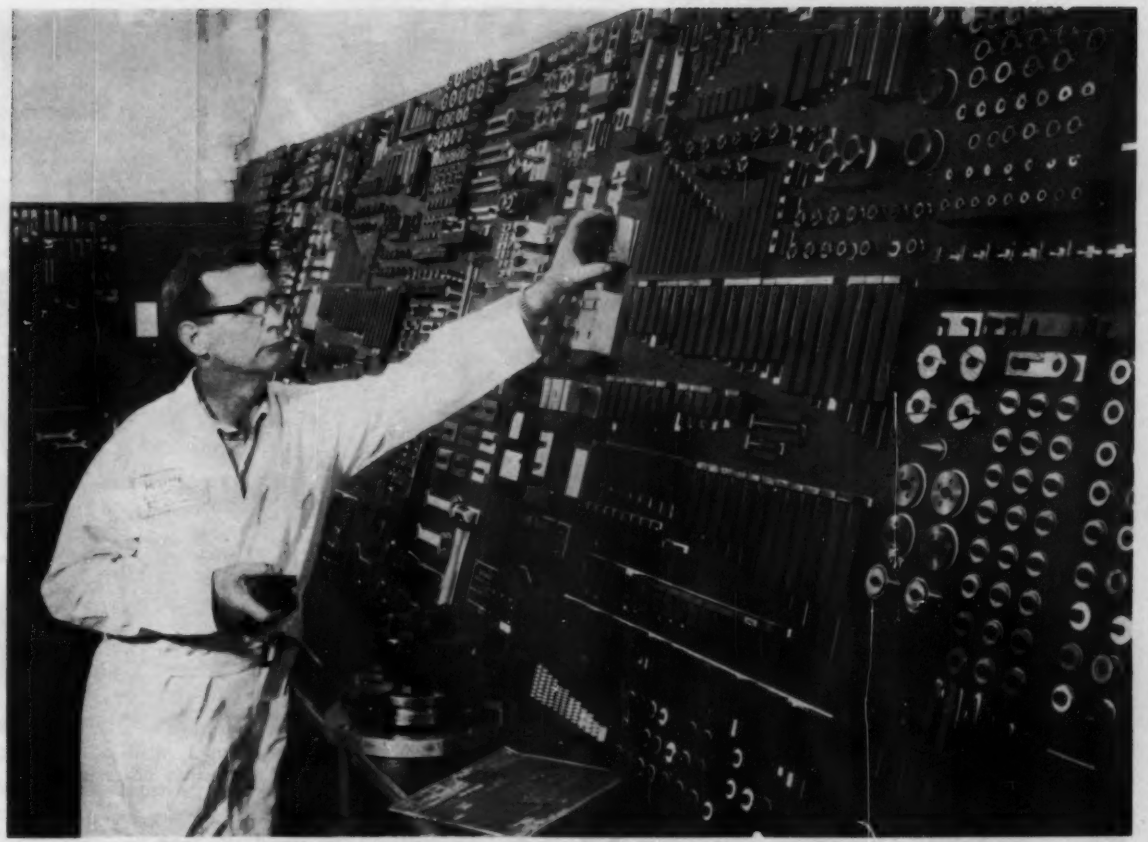
Casting quality

"A reliable die-casting machine, a properly designed die, and a suitable alloy are essential before die casting variables and quality can be made to meet requirements," said Al Sugar of Hydraulic Press Mfg Co. Other points covered in his paper on casting quality included controlled metal melting, molten metal delivery, sludge formation, and casting design.

Growth of the industry

The general growth of the die-casting industry was pointed up by the increased shipments of aluminum die castings from about 185 million pounds in 1955 to 370 million pounds in 1959. In the same period, shipments of zinc die castings increased by nearly 40% to 650 million pounds.

Die casting in the United States is performed at higher pressures than anywhere else in the world. And such developments as automatic wiping, automatic ladles, larger furnaces, improved materials handling equipment, better temperature controls, and higher quality alloys are continuing to improve the quality of die castings and to make the process more economical, said Joseph G Rayniak, vice chairman of the board and manufacturing research director of Outboard Marine Corp, in his dinner talk at the Exposition banquet.



Precision-ground components of building-block jigs and fixtures are stored on display boards for easy visibility and accessibility. Components are completely interchangeable, produce fixtures built to extremely close tolerances

Building-block fixtures for short runs

By Peter W Leferovich, project planning engineer, Hughes Aircraft Co

Engineering changes come so fast in the aircraft and missiles industry that conventional tooling is rapidly becoming obsolete and impractical. This is further complicated by the increasing complexity and precision of missile electronic parts.

Unitool system

Engineers at Hughes-El Segundo (Calif), plagued by as many as 1000 such changes a week, have found a solution to the tooling problem in the Wharton universal jig and fixture system. The "Unitools" which make up this system are precision ground and interlock with keys after they are accurately positioned with master locating holes.

These components can be put together in a wide variety of ways to build up any kind of jig or fixture, and they can be disassembled quickly and easily. After a fixture is used, its components are stored on display boards (photo) until needed for assembly of the same or another tool later.

With this method, tool design time is eliminated, large tool inventories are reduced, and changeover time from one job to another is cut to a minimum. This, added to drastically reduced toolmaking time, has cut manufacturing costs for short-run production of electronic systems significantly.

Hughes has 20 complete sets of Wharton Unitools, all of which can be put to use simultaneously if necessary. In most cases, a project planning engineer makes a sketch of the required tool, then gives it to a toolmaker for assembly.

A photograph of the assembled jig or fixture is made and filed under a part and tooling code number for identification purposes. When a rerun of the same part is required later, the tool can usually be reassembled in less than an hour.

Cuts tooling time 78%

Here is an example of the savings effected with the Wharton method at Hughes:

A turning fixture for a casting used in the Polaris guidance system required 40 hours tooling time by conventional methods. With Unitools, it takes 3½ hours.

Not long ago, 17 jigs and fixtures were made with Wharton components in a single week at Hughes. By ordinary methods, it is estimated that these same tools would have required 553 manhours to make. By the building-block method, Hughes did the job in just 120 hours.

Air flows at 40 fpm from the hooded working areas through the access opening. Air in the room is filtered to 0.3 micron particle size, is filtered again to supply these work areas in new clean room for assembly of precision bearings

Clean rooms to assemble instrument bearings

Precision instrument bearings are machined and assembled in new facilities with several unusual features at the Sandusky, Ohio, plant of New Departure Div, General Motors Corp. These include:

- Machines with specially balanced spindles, special precision ways, and hydrostatic workheads. These machines are operated continuously to maintain stability.
- Precision gaging equipment at each machine.
- Complete checks on roundness and concentricity with Talyrond and Indi-ron gages.
- Clean room for final inspection and assembly with individual hooded work positions.

Normally machines are kept running, even when not in use, 24 hours a day. When machines are shut down for lack of work or for maintenance, they are operated for 48 hours to assure complete temperature stabilization before being used for production.

All bearing parts are etched with serial numbers before heat treatment and complete inspection records are kept through all finish machining and assembly operations.

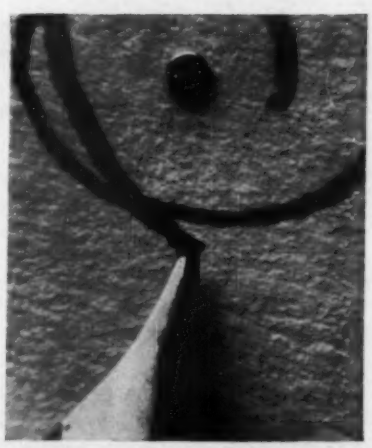
After final inspection and ultrasonic cleaning, the parts are transferred to the clean rooms where they are again given ultrasonic cleaning and further inspection before assembly.

Not air tight

No attempt has been made to make the clean rooms air tight. Instead a pressure difference of 0.05 in. water pressure is maintained between successive areas—with a total difference of 0.20 in. from the general plant area through the machining, inspection, and cleaning rooms to the ultra-clean assembly room.

Air is filtered through elements rated at 0.3 micron with a claimed efficiency of 99.9%. The volume of air provides 20 air changes per hour with humidity between 30 and 40% and temperature at 70 to 72 F.

Air from the cleanest room is two-stage filtered to supply the individual work spaces and these are provided with air to maintain a steady outward flow at 40 fpm.



Subminiature bearing (with pen point) has an ID of 0.01 in., an OD of 0.047, and contains eight 0.01-in.-dia balls

Walls are stainless steel and glass, leaning in at 3° to deter adhesion of any dust particles and deflect glare from the high illumination level of 200 ft candles. All steel in walls and trim is grounded to discourage static attraction.

Capital spending to hit $35 billion in 1961

American business now plans to spend $35.1 billion for new plants and equipment in 1961, only 3% less than in 1960. And preliminary plans for 1962 are very close to those for next year.

• Manufacturing industries as a whole will spend $13.93 billion, 3% below the $14.33 billion spent this year.

• The metalworking industry will invest $3.96 billion, down about 2% from 1960's capital outlay of $4.04 billion.

While such spending plans are always tentative, they are especially so this year because of uncertainties in the general economy and in government policy. But the high level of capital investment now planned by business in a period of declining profits and declining industrial activity should provide a strong support for the general economy in the year ahead.

Capital spending plans of manufacturing companies (billions of dollars)

	1959 (Actual)	1960 (Est.)	1961 (Planned)	1960-61 % Change	1962 (Planned)
Machinery	0.91	1.15	1.11	−3	1.11
Electrical machinery	0.52	0.62	0.68	+10	0.63
Autos, trucks & parts	0.64	0.89	0.95	+7	1.02
Transportation equip. (aircraft, ships, R.R.)	0.39	0.41	0.37	−10	0.35
Other metalworking	0.88	0.97	0.85	−12	0.87
ALL METALWORKING	3.34	4.04	3.96	−2	3.98
Iron and steel	$1.04	$1.52	$1.37	−10%	$1.18
Nonferrous metals	0.31	0.34	0.34	0	0.32
Chemicals	1.24	1.61	1.64	+2	1.59
Paper and pulp	0.63	0.75	0.69	−8	0.53
Rubber	0.19	0.24	0.23	−4	0.20
Stone, clay, glass	0.53	0.63	0.56	−11	0.55
Petroleum & coal products	2.49	2.45	2.52	+3	2.50
Food and beverages	0.82	0.94	0.99	+5	0.97
Textiles	0.41	0.53	0.42	−21	0.40
Miscellaneous mfg.	1.07	1.28	1.21	−5	1.13
ALL MANUFACTURING	12.07	14.33	13.93	−3	13.35

1960 a disappointment

Capital expenditures for 1960 fell considerably short of what had been predicted last spring, and many firms appear to have stretched out this year's spending plans into next. Disappointing as the year may have been, 1960 capital expenditures by manufacturing companies as a whole, and by metalworking, were up about 20% over 1959. These are the findings of the new McGraw-Hill Economics Department fall survey of capital spending plans.

But not everyone is trimming. Several manufacturing industries are planning to increase their capital spending in 1961, and leading the way are two segments of the metalworking industry—the electrical machinery and auto industries.

Manufacturers of electrical machinery plan to spend $680 million on new plant and equipment in 1961, a 10% jump over the $620 million spent this year. But this year's expenditure is well below what had been anticipated last spring.

The same holds true of the auto industry. Capital investment did not live up to expectations. Expenditures amounted to $890 million in 1960 (well below the anticipated $1.02 billion) but are expected to hit $950 million in 1961, an increase of 7% over last year. The auto industry, incidentally, is the only manufacturing industry planning a significant increase in capital spending in 1962.

The largest decrease in capital spending in the metalworking industry is the 12% cut planned by the "other metalworking" industries—fabricated metals and instruments. In 1961, they will spend $850 million, 12% under the $970 million invested in 1960.

Transportation equipment manufacturers will trim 10% off their capital expenditures. This year's total ran to $410 million, next year's will be $370 million.

Builders of non-electrical machinery are forecasting a 3% decline in capital spending next year. Current planning calls for an outlay of $1.11 billion 1961, compared to a figure of $1.15 billion in 1960.

The steel industry plans to spend nearly $1.4 billion for new plants and equipment next year. It will be the third highest year on record, although 10% below this year's investment. Nonferrous metal producers will invest $340 million in 1961, just about equal to their 1960 outlay.

Manufacturing sales outlook

Manufacturers foresee sales increasing by about 3% in physical volume in 1961. Builders of non-electrical machinery anticipate a gain of 5%; electrical machinery, 3%; automotive, 0%; transportation equipment, −4%; other metalworking, 5%.

The transportation equipment industry is the only manufacturing industry expecting a decline in sales volume. The auto industry, now completing what will probably be its second largest car sales year in history, sees 1961 sales on a par with 1960.

Other manufacturing industries replying to the survey predict sales increases ranging from 1% to 4%.

Capacity, operating rates

Every manufacturing industry—except the rubber industry, which is partially geared to the model changeover in the auto industry—was operating at a lower rate of capacity when this survey was made than at the end of last year. Manufacturers, on the average, were utilizing 79% of capacity. Except for the end of 1957, this is the lowest operating rate recorded since 1954.

Companies taking part in this survey are usually the larger companies in their industry. However, in each successive survey an effort is made to include more medium-sized and smaller companies. More concerns in this size range cooperated in this year's survey than ever before.

Random sampling boosts labor performance

With a formal performance-observation program, an aircraft-missile parts maker has cut idle time, increased effective use of productive time by 16%. Here are complete details on the program

By **John Millikin,** manager,
Industrial Engineering Dept, Aircraft Div, Twin Coach Co, Buffalo, NY

With a technique borrowed from quality control, the Twin Coach Co now gets from its labor force, each week, an additional 4800 *productive* manhours, compared to a year ago. Translated into dollar figures, these weekly 4800 hours (once written off as idle time) add up to more than $700,000 a year.

The technique might be called *random sampling of people.* The theory here is that, if enough random observations are made, we can get a reliable measure of the work—idle ratio for groups of workers in each plant area. From these random measurements come statistics that, issued in weekly reports, give management a quick evaluation of group and departmental performance. And with the reports supervisors can pinpoint labor problems that require corrective action.

In our Performance Evaluation Program, which we call PEP, trained observers enter plant areas at random times along random routes. By making head counts of working and idle employees, they establish statistics that show how effectively workers are making use of their time.

PEP results

Thus we get every week, for each area in each department, a percentage figure that shows the effective manhour utilization. This figure, compared to a preselected target figure, shows how efficiently workers in an area have performed. As a spur to reduce idle time, we have an incentive program for supervisors whose weekly percentage exceeds a norm.

Started in July, 1959, the observation program reached full coverage of day-shift, direct-labor areas on October 1st. But before we could install the program in Twin Coach's Aircraft Division plant (Buffalo, NY), we had to conduct an intensive training course. Here Industrial Engineering personnel, who would act as observers, were indoctrinated in work-sampling theories and techniques. This training was extremely important, because the observers had to learn to interpret each element in the program exactly the same way.

Before assigning observers to the various departments, we made a systematic analysis of floor space, layout, and the number of workers to be covered by each observer. Layouts of the factory area were made, so that the overall plant could be subdivided into measurement areas.

Making observations

In practice, the observer enters the area that he will measure—at random times and along random routes—and physically counts the number of people working and the number that are idle. During the week, he repeats this procedure many times, carefully keeping a record of each observation.

The PEP observer is under strict orders to divulge no names of individuals or groups to anyone; he deals entirely in head-count numbers. If he deviates from this rule, the result can only be that people being observed will make special efforts to circumvent the observer's techniques. And the observer has no responsibility for discerning and correcting problems that arise in an area. These problems are the responsibility of supervisors; the observation will only outline the existence of a problem. Too, an impersonal observer is less prone to create incidents that involve workers' reluctance to be measured.

Weekly reports

At the end of the week, observers turn in all their records to a clerical group. At the same time, this clerical group receives from Data Processing a record of the total time charged to each area being measured. From these records the group prepares a utilization perecentage for each area:

$$\frac{\left(\begin{matrix}\text{Total Time}\\ \text{Charged}\end{matrix}\right) - \left(\begin{matrix}\text{Out of}\\ \text{Area}\end{matrix}\right) - \left(\begin{matrix}\text{Idle}\\ \text{Time}\end{matrix}\right)}{(\text{Total Time Charged})}$$

Reports are issued weekly, in a format that keeps paperwork at a minimum. Issued to each level of supervision, they show the weekly manpower utilization. Each report gives the percentage figure, for the current and previous week, of four major categories of productive and non-productive activities:

Productive—All productive activities, setups, and handling and procurement in the immediate work area.

Non-Productive (Allowable)—Giving or receiving instructions, clerical delays, company-sponsored interference, delays caused by service organizations and clean-up.

Out of-Area—Operators not in the assigned work area.

Disallowable Delay — Idle, talk, wait, and walk.

Each report comes out as soon as

possible the following week, so that supervisors can immediately take corrective action. The report, which is perpetual, includes an "operating range" for each area covered, based on a six-week analysis of the productive category. Also called a target band, this operating range for each area is an equitable gage for comparing one area's performance with another's.

Acceptance of programs

It is unfortunately true that employees look with suspicion on most management efforts to improve efficiency. The Performance Evaluation Program is no exception.

In meetings with foremen and union representatives, we always make the point that what Twin Coach sells, as an aircraft and missile sub-contractor, is our **productive manhour.** If Twin Coach offers a manhour that is 50% productive, and competitor "A" offers a 70%-productive manhour, there can be no doubt about which one the customer will select.

Although union officials have not officially endorsed the program, their actions have shown maturity, restraint, and an understanding of the problem. They clearly—and correctly—feel that it is management's job, not theirs, to sell the need for efficiency.

Our customers have accepted the program with enthusiasm. Chance Vought, for example, was of great help in establishing the program. Representatives from Boeing's Industrial Engineering Dept have shown much interest in all aspects of PEP. And Navy officials not only have asked for a presentation, but have requested that they be allowed to encourage similar programs in other companies.

Supervisory incentives

Because the first and second levels of supervision control manhour utilization directly, we started an incentives program for supervisors, based directly on their success in keeping workers gainfully employed. The foreman's success in coping with daily problems of controlling his manpower, materials, and tools is reflected directly in the weekly PEP rating of the workers he supervises. Foremen know that if they produce outstanding results, there will be immediate and direct rewards.

In the incentive system, we make use of three figures to determine how much will be paid to supervisors:

1. *The supervisor's PEP rating each week.* This is the manpower utilization expressed as a percentage of the total time charged.

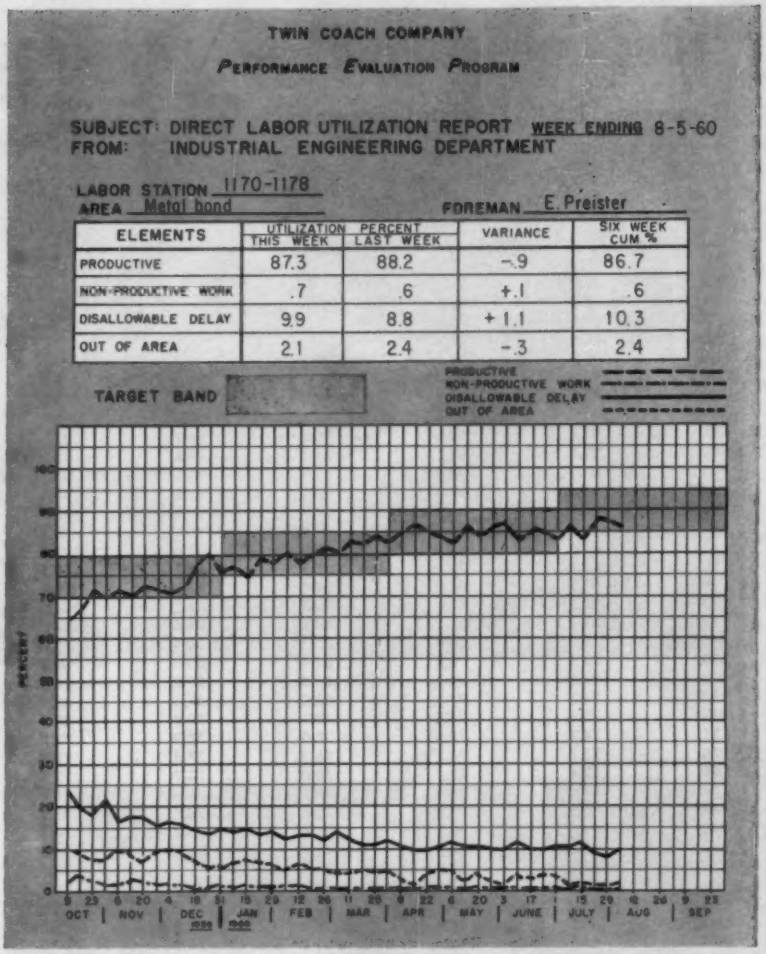
2. *An area factor for each area covered under the program.* Management realizes that the various areas have different working problems and conditions, and that all cannot achieve the same PEP rating. Each area, therefore, was analyzed and given a top possible PEP rating, thus equalizing the opportunity of each area to reach 100%.

3. *Incentive rate schedules.* These enable the foreman to determine the amount of his incentive.

Calculation of incentives works this way: Each week the foreman receives a report of his manpower-utilization (PEP) factor; he already knows his area factor. Entering a table with these two figures, he reads off his PEP efficiency (the PEP rating divided by the area factor). Entering a second table with his efficiency rating, he can then read off an incentive rate, expressed as a percentage to be added to his base pay rate. (See box, next page, for tables and example.)

To help the foreman reach his goal of better performance, we also have set up incentives for the various service departments upon whom he depends: tooling, material procurement and handling, engineering, maintenance, quality, etc). These departments receive an incentive based on the success of their combined efforts as indicated by the plant-wide utilization average.

Although it is not possible to predict what the exact weekly incentive will be, it is possible to mark off the perimeters of the incentive, based on present conditions. If all areas were to achieve a 100% PEP ef-



Weekly performance report shows how each plant area has utilized its productive time. Note that, since inception of observation program, productive use of time has risen steadily, with corresponding decrease in non-productive and out-of-area time

Chart No. 1

Supervisor P.E.P. Efficiency Formula = P.E.P. Observation % / Area Factor

P.E.P. Obser. %	95	94	91	90	89
95	100.0				
94	98.9	100.0			
93	97.9	98.9			
92	96.8	97.9			
91	95.8	96.8	100.0		
90	94.7	95.7	98.9	100.0	
89	93.7	94.7	97.8	98.9	100.0
88	92.6	93.6	96.7	97.8	98.9
87	91.6	92.6	95.6	96.7	97.8
86	90.5	91.5	94.5	95.6	96.6
85	89.5	90.4	93.4	94.4	95.5
84	88.4	89.4	92.3	93.3	94.4
83	87.4	88.3	91.2	92.2	93.3
82	86.3	87.2	90.1	91.1	92.1
81	85.3	86.2	89.0	90.0	91.0
80	84.2	85.1	87.9	88.9	89.9
79	83.2	84.0	86.8	87.8	88.8
78	82.1	83.0	85.7	86.7	87.6
77	81.1	81.9	84.6	85.6	86.5
76	80.0	80.9	83.5	84.4	85.4
75	78.9	79.8	82.4	83.3	84.3
74	77.9	78.7	81.3	82.2	83.1
73	76.8	77.7	80.2	81.1	82.0
72	75.8	76.6	79.1	80.0	80.9
71	74.7	75.5	78.0	78.9	79.8
70	73.7	74.5	76.9	77.8	78.7
69	72.6	73.4	75.8	76.7	77.5
68	71.6	72.3	74.7	75.6	76.4
67	70.5	71.3	73.6	74.4	75.3
66	69.5	70.2	72.5	73.3	74.2
65	68.4	69.1	71.4	72.2	73.0
64	67.4	68.1	70.3	71.1	71.9
63	66.3	67.0	69.2	70.0	70.8
62	65.3	66.0	68.1	68.9	69.7
61	64.2	64.9	67.0	67.8	68.5
60	63.2	63.8	65.9	66.7	67.4

AREA FACTOR

Chart No. 2

P.E.P. Incentive Rates

75.5	—	1%
76.5	—	2%
77.5	—	3%
78.5	—	4%
79.5	—	5%
80.5	—	6%
81.5	—	7%
82.5	—	8%
83.5	—	9%
84.5	—	10%
85.5	—	11%
86.5	—	12%
87.5	—	13%
88.5	—	14%
89.5	—	15%
90.5	—	16%
91.5	—	17%
92.5	—	18%
93.5	—	19%
94.5	—	20%
95.5	—	21%
96.5	—	22%
97.5	—	23%
98.5	—	24%
99.5	—	25%

EXAMPLE—John Black, foreman, has a base rate of $130 a week. He knows that his area has a 90% PEP observation-area factor. When he receives his weekly PEP analysis sheet, he finds that his observation level was 80% for the week.

Going to Chart No. 1 and entering with his observation level and his area factor, he finds that his PEP efficiency factor for the week is 88.9%. Now he enters Chart No. 2 with this efficiency factor, and discovers that his earned incentive is 14% of his base pay for that week. Converted to dollars, this percentage becomes $18.20. Thus his total compensation for the week is $148.20. Notice (Chart 2) that each foreman can boost his weekly pay as much as 25%

ficiency factor, we would be committed to add 25% to the base pay of 130 people. At an average base rate of $130 a week, the maximum cost would be $32.50 an individual foreman per week, or a total cost of $4225 a week. But the saving at this point would exceed $70,200 for the week!

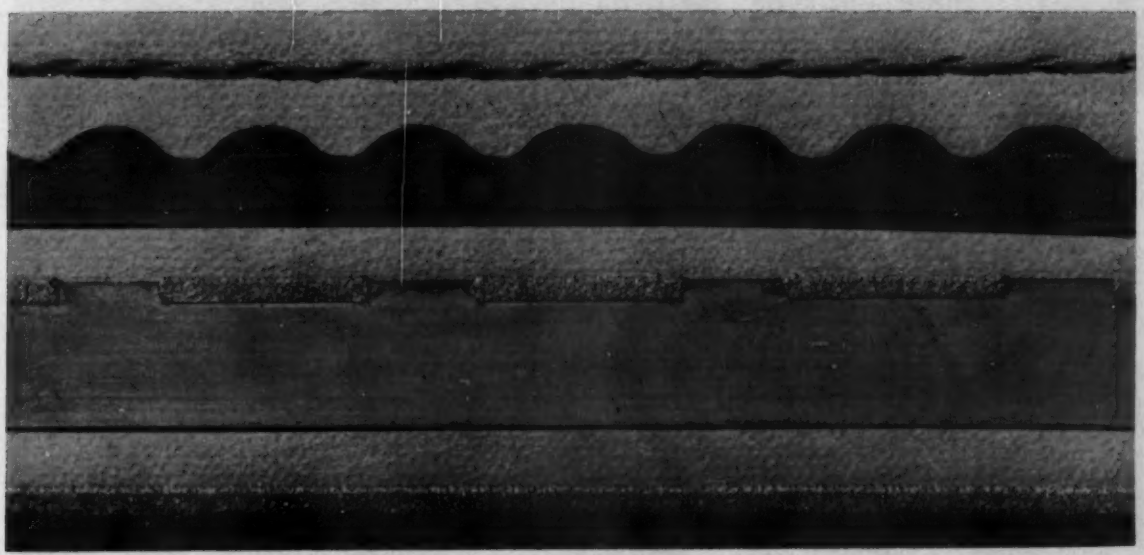
Further improvement in direct-labor areas should come from the program, although the rate of improvement will probably be less rapid as we approach higher utilization figures. The first sharp focusing of attention on performance has brought out many areas of improvement. Corresponding improvements have been made in indirect labor, although we have not yet achieved full coverage of all indirect labor. Our initial investigations here indicate substantial gains, particularly in layouts and procedures. To date, our observations of indirect labor have brought major revisions in filing and posting systems, and layout changes have resulted in improved utilization.

Besides making further improvements in labor performance, we are collecting data as the first step in improving other phases of our operation: machine utilization and loading, space utilization, and work-in-process and inventory reduction—to name only three.

Vital information—some of it impossible or impractical to get any other way—is being obtained by our PEP program. Moreover, the cost of getting this data is a minute fraction of the cost of obtaining the same information by time studies and other forms of observation.

The PEP program is, of course, not a static affair. We expect continued advances. When we reach the potential of the program, we estimate that our customer will be able to buy, *for the same labor cost*, 17½ units for every 10 he buys now.

Diamond-coated bandsaws do "impossible" jobs



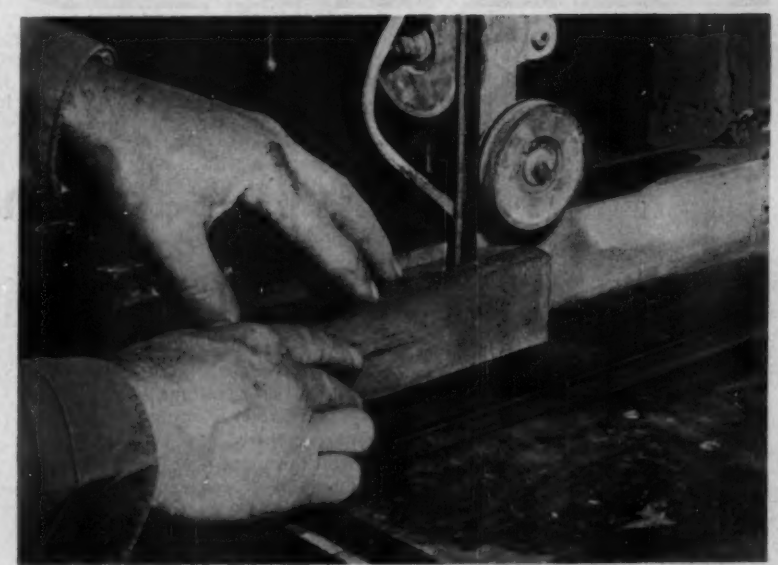
Typical diamond-coated bandsaw blades include a twist-coated wire (top), a serrated edge that improves cooling, a spaced-edge blade, and a continuous-edge blade

By Lee H Barron, president,
Dia-Chrome Co, Glendale, Calif

Steel bandsaw blades are now being coated with small natural diamonds to make fast contouring cuts in such difficult materials as carbide, glass-reinforced plastics, and ceramics. The development was originally a solution to laboratory cutting problems in missile and electronics work, but has since become a production tool.

The blades can be any shape or size that will operate in a standard bandsaw machine, and are MC-1 clock-spring steel to which diamonds are bonded along the edge or face. The best application to date has been for rough, hogging cuts where the diamonds cut fast and with minimum vibration.

Blade styles range from twist-coated wire to bands 1¾ in. wide and 0.080 in. thick along the coated edge. Fully coated blades are generally 0.060 in. thick.



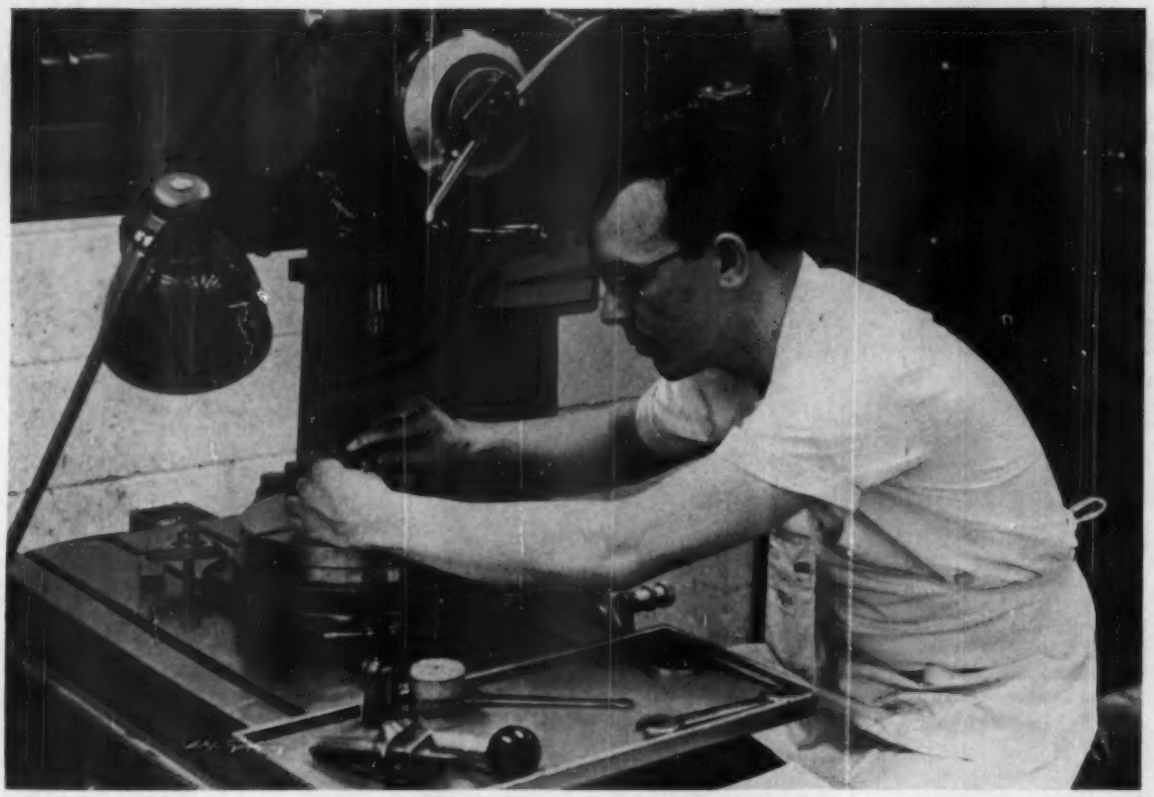
Water cools the blade when coated diamonds saw nitride-bonded silicon carbide. Rubber-coated wheels guide the saw, tension the blade, and prevent vibration

Adapting the machine

The only necessary change in the bandsaw machine is to mount rubber-tired guide wheels above and below the table, with about 10 in. of tensioned free saw in the cutting area. Operating speeds are usually 1200 to 1500 sfpm, but 2000 sfpm works for long bands. Coolant (water or emulsion) should be applied for carbide and heavy ceramics, but plastics may be cut dry.

The same coated blades can also do hole sawing. A manufacturer of hard-carbon seal rings cuts inside and outside circles in carbon stock with sections of 1¾ in.-wide blade (continuous edge) in a circle cutter.

Successful cutting, some of it practically impossible by any other method, has been done on such materials as ferrite, ceramet, Pyroceram, and germanium, as well as tungsten carbide (all hard materials).



Locally recruited tool and diemaker apprentice Clark Denise is in his first year of training, works with the second shift (4 pm to 12:30 am), yet manages to squeeze in classes at North Carolina State College, where he is a senior in Electrical Engineering, during the day. Denise exemplifies the willingness of North Carolinians to work long hours in an effort to upgrade themselves to meet increasing automation-created demands for highly skilled workers.

Training for automation

By R F Katis
Supervisor of Training
Raleigh Meter Plant
Westinghouse Electric Corp.
Raleigh, N C

While automation is undoubtedly replacing the unskilled and the semi-skilled production worker in many industries, it is at the same time creating new demands for craftsmen. Automated machinery simply cannot be produced, operated, and maintained without skilled workers. But the problem of finding such skills, or developing them, in a plant located in a primarily agricultural area is a knotty one.

Westinghouse Electric Co ran up against a shortage of skills when it opened its meter plant at Raleigh, N C, in 1954. There were virtually no tool designers, no tool and diemakers, and no model makers on the local labor market. The chief local source of labor was the farm—people utterly without technical training or industrial experience, to whom a six-inch scale or a micrometer were as unfamiliar as a digital computer. Engineers were of course non-existent.

And the plant is highly automated.

Obviously, a cadre of engineers and skilled men had to be brought in, not only to get the plant into operation, but to set up some method of instilling metalworking skills into the local labor force.

The main problem was in getting men who could translate the engineer's idea into a production reality—in other words apprentices. To kick off the program, the company advertised in North Carolina newspapers for 10 high school graduates with a minimum of two years of mathematics and two years of science.

The results were gratifying and surprising. More than 250 young men responded. After careful screening, they were tested for eight hours on reading, arithmetic, verbal intelligence, mechanical ability and dexterity, sociability, dependability and persistence, ability to understand oral direction, mechanical comprehension, and general math—in addition to general IQ and mental age tests. This was in December, 1955.

Four years later, the Raleigh plant graduated its first apprentices: nine tool and diemakers and one model maker. This year, four more tool and diemakers and one model maker will graduate, with a third class of seven tool and diemakers and one model maker scheduled to become journeymen in 1964.

To accomplish this, the plant's Apprentice Council has taken advantage of Westinghouse's long (since 1896) experience in training

apprentices. It follows, for example, such training precepts as teaching the apprentice to coordinate head and hands, to analyze and develop, to prove and not assume, and to perform many tasks formerly assigned to junior manufacturing engineers.

The council has, in addition to undertaking training of tool and die and model makers, attempted to go beyond what is ordinarily expected in the training of an apprentice—ultimately developing a skilled electro-mechanical technician, a craftsman who works with carbide dies that cost as much as $25,000 each, and with tools valued in the millions of dollars. Such a man must understand electrical circuits, read a drawing as well as he reads English, must know steel as a carpenter knows woods, and must be able to work from engineers' verbal instructions as well as from blueprints.

Westinghouse-Raleigh's tool and diemaker and model maker apprenticeships cover four years, are divided into 12 semesters. Shop assignments account for 8000 hours, while another 1000 hours go into related instruction in the classroom on company time The apprentice receives a bonus of 50 hours per semester if he maintains an A average in classroom work. He is graded every semester in classroom studies and every month in the shop.

$10,000 to train apprentice

Although the company estimates it costs $10,000 to train a craftsman, there are no strings attached. He may quit the day he completes.

The Raleigh plant's apprenticeship courses follow precepts laid down by the U S Bureau of Apprenticeship in that the apprentice is rotated through such departments as the toolroom, model shop, maintenance department, tool design, and the like. One unique phase of training that the apprentice must undergo at Raleigh, however, is a spell in the Low Quantity Order Department, where he learns to make special tools to produce parts for watthour meters that are no longer in production but must still be serviced.

Westinghouse-Raleigh's apprentices are encouraged to be creative. In the Model Department, for example, the apprentice learns to invent his own tools. Then, too, apprentices are frequently consulted for ideas on one of the company's most pressing problems—saving materials. Through a Die Analysis Study, a complete history is kept on each piece of machinery, and on each tool and die.

If overhaul of any of these exceeds 10% of its original cost, the company wants to know why. Under the plant's die control system, die runs range from 4000 to 500,000. If repair is too frequent, a die may be redesigned or another material substituted. If the apprentice has an idea how to do it, well and good.

Design draftsman course

In addition to the shop apprentice program, the Raleigh plant has a three-year design draftsman apprenticeship. The first class, six men and one woman, finished this June. Instruction is supplied by the Extension Division of North Carolina State College and is given in the plant on company time. This program is unique in that all courses are college accredited.

This group of apprentices, incidentally, ranges in age from 21 to 30 years, and all are married. Four were selected from company applicants and three from outside—all high school graduates.

On completing training, these apprentices are equipped to become design draftsmen. They have as part of their training 6 to 9 hours of classroom work a week in mathematics, manufacturing processes, kinematics, general electricity, and technical writing. Courses are so planned as to teach the apprentice to work directly with engineers in putting ideas on paper, and then in developing the product.

In establishing a new, highly automated plant in a rural area, Westinghouse could not, and did not, overlook supervisory training. A group of 20 men, mostly college graduates, were selected from the Raleigh area and sent to the parent plant in Newark, N J, for training.

This training was later supplemented at Raleigh by a man-management program consisting of a series of seminars on individual responsibility, improving employee relations, and leadership. With these seminars as a nucleus, all kinds of training programs were initiated.

For example, in 1958 the plant sponsored a night school program to teach subjects not available through Raleigh area schools. Object: to provide training and knowledge to help employees upgrade themselves in technical jobs.

Actually, night classes were established for day workers, while night workers attended afternoon classes. More than 200 employees attended these in-plant courses during nonworking hours. Most of the instructors were plant employees whose services were paid for out of a nominal registration fee that also covered equipment and supplies.

The company felt that the registration fee would limit the courses to those really interested, but it did make a sizable grant to take care of any possible deficit. These classes, whose curricula vary from extremely technical courses to high school subjects and clerical work, are still continuing on a limited basis.

In line with its upgrading of employees, Westinghouse-Raleigh regularly selects personnel with management, technical, and supervisory potential and sends them to Westinghouse headquarters at Gateway Center, Pittsburgh, for training.

Still another boost to upgrading of employees is given by an Education Assistance Program. Under this, any employee who has worked at the plant—for a year or longer, and who takes college courses to better train for his work is refunded half the tuition for college degree credit courses in which he earns at least a C. If he obtains the degree while working at Westinghouse, the company will refund (in a lump sum), the remaining portion of all tuition.

For new employees, or for workers going on a new job, Westinghouse-Raleigh provides orientation training. Another company-provided service is safety training, which has paid off handsomely: The company has had 2-million worker hours without a disabling injury.

Success story

Six years ago, Westinghouse walked in cold into the primarily agricultural Raleigh area to set up a highly automated plant, requiring a high degree of worker skill. Today, the plant has 1000 employees, 60% of them women, turning out a product that is said to require more technical know-how than a fine watch.

A single-phase meter, for example, requires 350 labor operations and 265 separate parts. Yet the job of producing it and many (84 to be exact) types of complex meters is being done in a large degree by people who just a half-dozen years ago were farmers completely unfamiliar with even the most basic operation.

The plant's success is directly attributable to the opportunities it has afforded these people to upgrade themselves—no small incentive in a rural area. Intensive training at all levels has more than paid off in mutual benefits to the company and its employees.

PLASTIC TOOLING

Low investment and quick return are the end results of five years' plastic tooling research and development at General Electric, where a company-wide effort to apply it to all kinds of products, from appliances to missile parts, is saving $3 million a year

By Donald E Dutt, senior engineer and Howard S Mather, engineer

Manufacturing Process Development Service

General Electric Co
Schenectady, N Y

Plastic tooling is a recognized time and money saver, although generally regarded as suitable only to the automotive and aircraft industries. But why can't it save time and money in a highly diversified company, or even in the job shop, too?

A few years ago, General Electric, which has a product mix ranging from few-of-a-kind missile components to mass-produced home appliances set out to find whether plastic tooling and modelmaking really is the exclusive bailiwick of the automotive and aircraft industries.

It most certainly isn't.

Today, five years after launching its first investigations, General Electric estimates that it saves $3 million a year by substituting plastic materials and tooling techniques for conventional materials and methods.

GE-conceived applications for plastic tooling, shown on these pages, range from foundry patterns to jet engine mockups, from surface plates to Hydrotel masters. One and all, they are prime moneysavers. And one and all they are the end products of a broad companywide R & D program designed to encourage engineering initiative in GE plants.

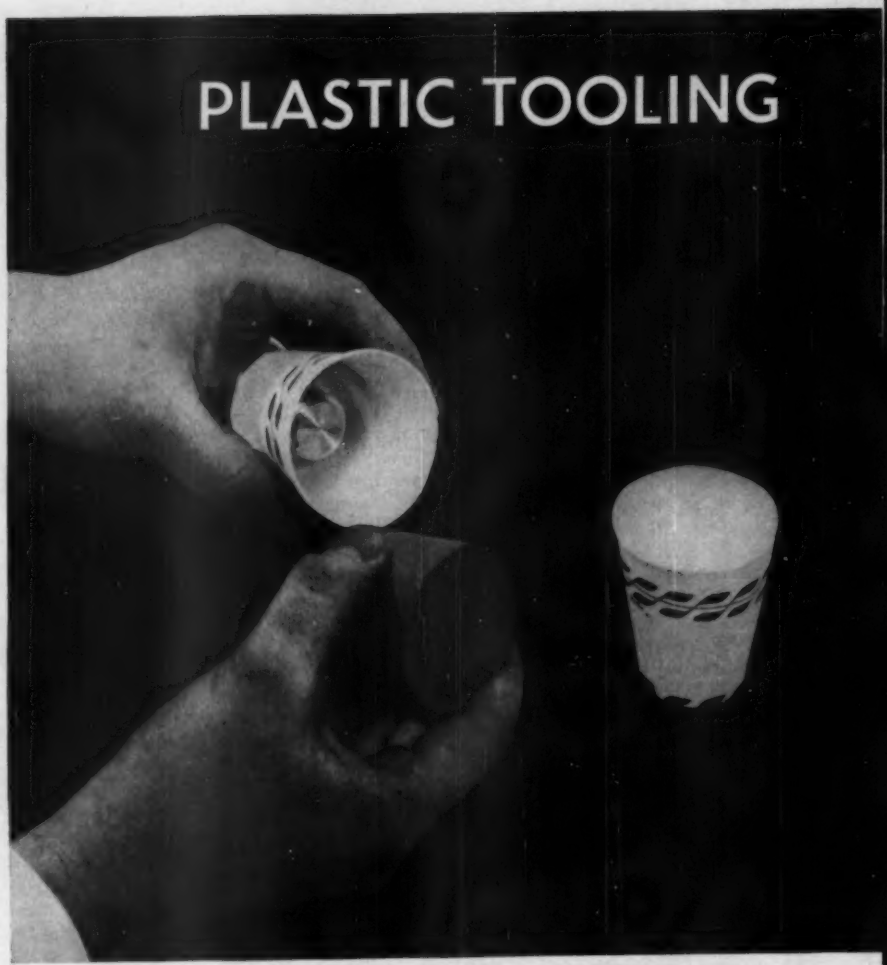
The company launched its investigations into the possibilities of plastic tooling by consolidating all available information on the subject, including successful case histories from other firms. GE's Tool Development Laboratory at Schenectady then went to work, using commercially available epoxy formulations to construct tools, dies, gages and models for widely differing applications. Frequently, in the years since, the Laboratory has developed many of its own toolmaking techniques.

September, 1955, saw the beginning of a companywide Plastic Tooling Program consisting of group presentations on plastic tooling and model-making techniques and materials to manufacturing engineers at GE plants throughout the country.

At the same time, each plant's manufacturing area was carefully examined to determine to what extent plastic tooling could be applied to operations. Those plants with plastic tooling potential then sent representatives to a two-week workshop seminar at the Tool Development Laboratory in Schenectady.

Here, after a day or so of briefing on basics, students went to work on actual projects, constructing their own tools, using various epoxy casting and laminating procedures. Many of these tools were later placed in production in the student's own plants. This "learn by doing" method of instruction has since proved the most effective method of teaching those who must later communicate ideas to others.

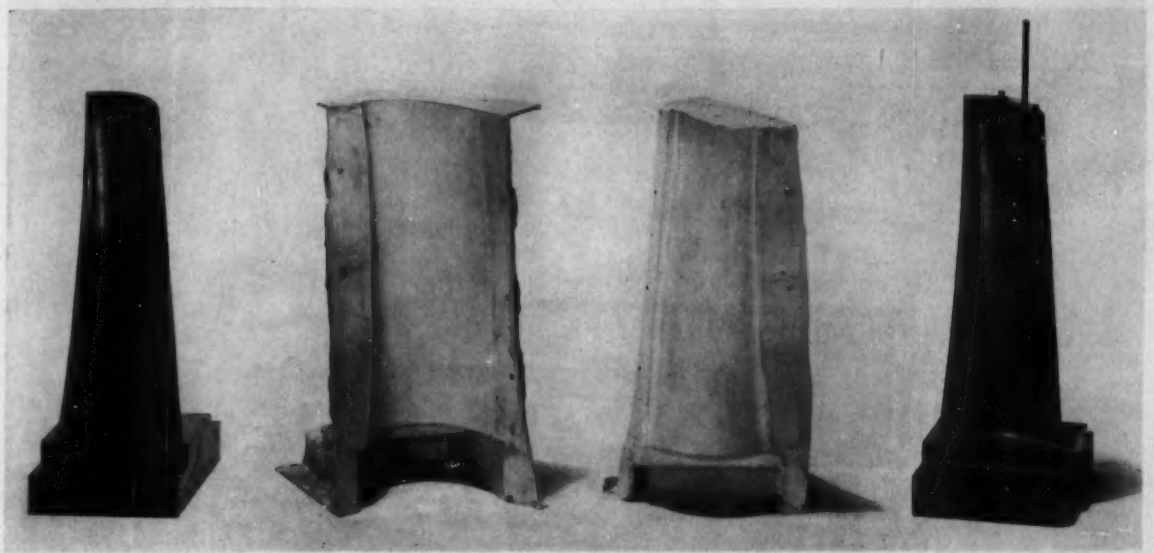
More than 200 GE employees have attended plastic tooling workshop seminars in the last five years. Each of them has returned to his own plant, not only to apply his knowledge to problems in his own plant, but to act as instructor in plastic tooling to co-workers. As a result, this single program has indirectly trained many times the original number of manufacturing personnel. And as a result, too, it has saved the company millions of dollars each year in tooling a wide variety of products.



Simplified mold-making technique, developed at GE's Light Military Electronics Dept, Utica, N Y: Model is held in place on bottom of Dixie cup with piece of double-back adhesive, and liquid RTV silicon rubber (made by GE's Silicone Products Dept) and curing agent is poured in. After curing overnight at room temperature, finished mold (shown being removed from cup) is strong, durable, and flexible enough so that even the most complex parts can be removed with a minimum of effort. Mold is ideal for casting models or encapsulating electronic parts

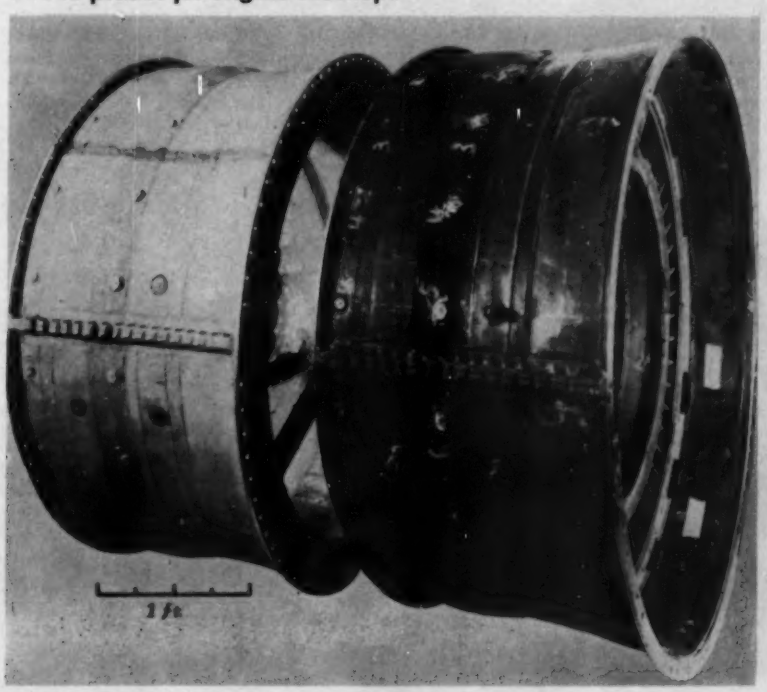
finds new worlds to conquer

from Hydrotel masters . . .

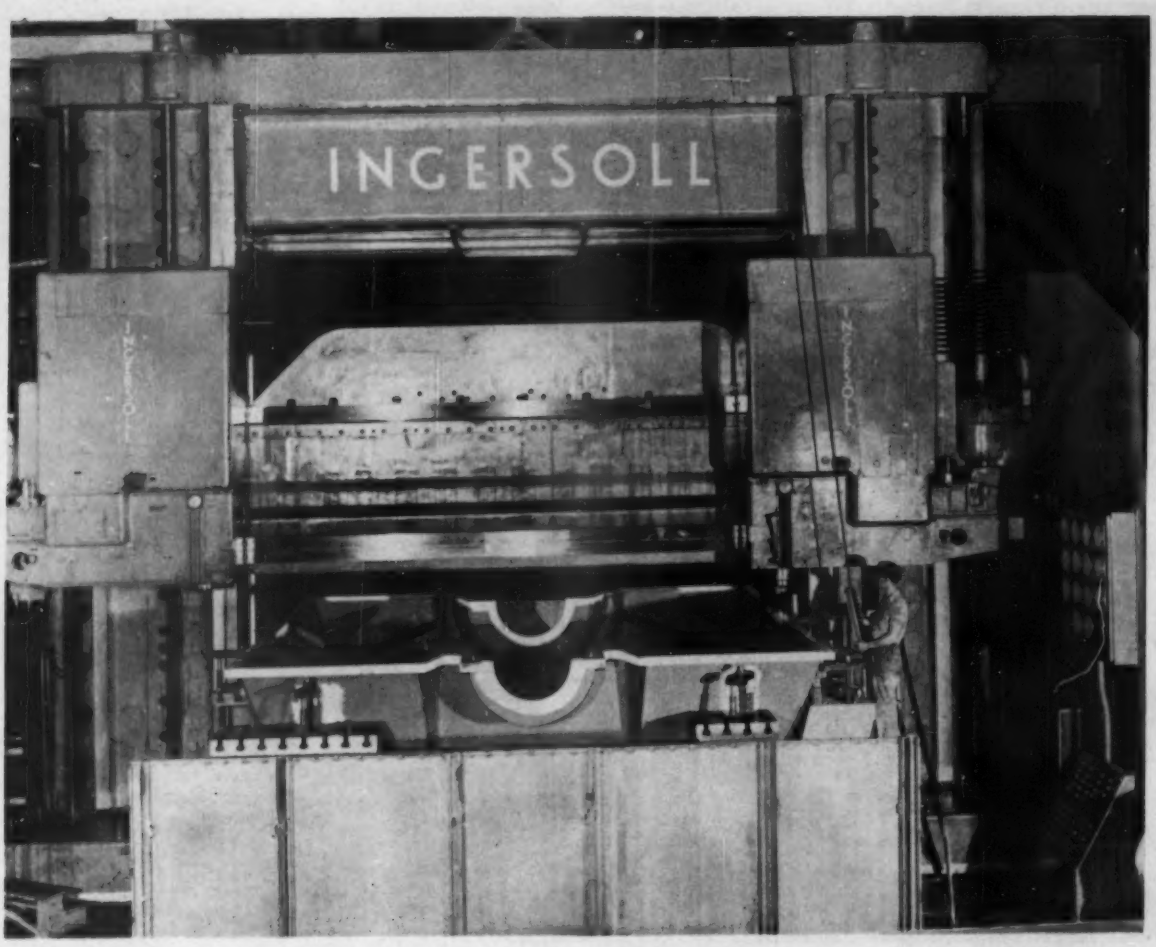


Epoxy plastic masters for Hydrotel profiling machines were developed by GE's Gas Turbine Dept, Schenectady. From wooden model (left), a two-piece glass-laminated mold is made (center), and the silicon-carbide-filled epoxy master is cast (right). Originally, steel masters were machined from a wood model: cost of a steel master was about $2500. This plastic master for a 4-spindle Hydrotel profiling machine cost about $250

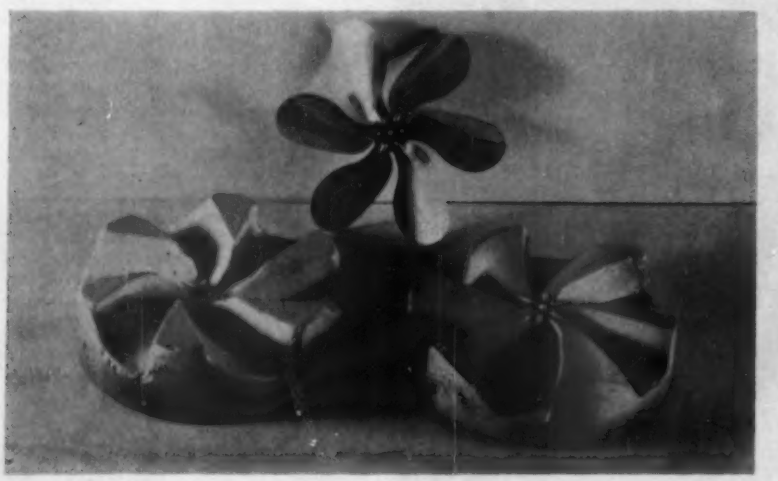
. . . to plastic jet engine mockups



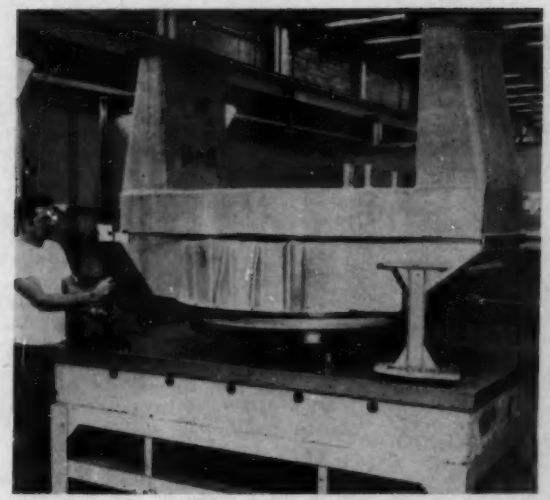
Jet engine mockups like this one are now being made of plastic instead of wood at GE-Evendale (Large Jet Engine Dept). Plastic is more durable, more stable, more versatile, and lighter than wood. Often, actual components can be used as patterns, without damage to the components. Plastic turbine cast (left) was made from an actual production pattern (right). Wooden mockups deteriorated with use and time, had to be reworked periodically to tighten assemblies and correct dimensional changes. Not so with plastic mockups



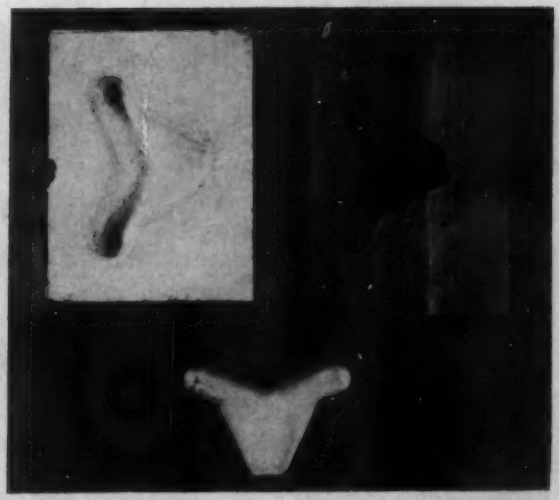
Repairs on an Ingersoll planer-miller would ordinarily have taken 1½ months, were done in three days with plastics at the Large Steam Turbine Dept, Schenectady. A steel chip lodged in the bed produced a 16-ft-long score. Bed was cleaned and cavity filled with iron-filled epoxy resin, which was then scraped down to original bearing surface. At same time, 16 oil grooves in machine bed were similarly repaired. Another repair job was done on a 16-ft Sellers planer which had a 30-in.-long piece broken out on a slide bearing. Piece was put back in position, doweled, and cracks filled in with epoxy. Next day, excess plastic was scraped flush to surface. Total downtime: 3 days. Estimated savings: $29,000



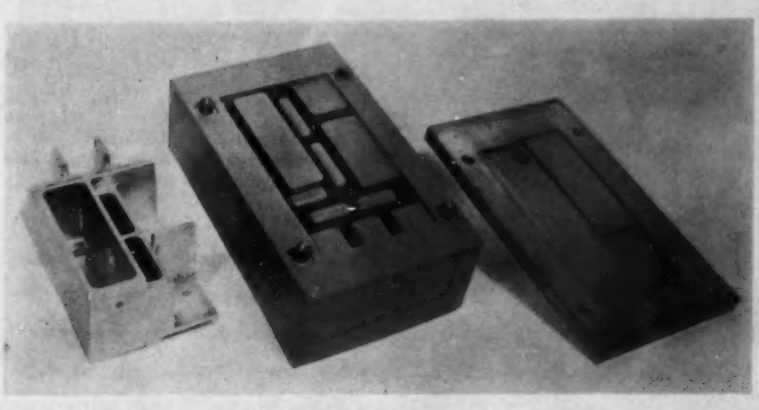
Plastic form die for 6-element fan blade was made at GE's Automatic Blanket & Fan Dept, Bridgeport, Conn. Formerly a "master set" was cast from the original engineering model (so as not to lose the contour development). Now plastic dies have replaced cast-iron dies, cost only a third as much. This plastic die produced 300,000 aluminum blades over a two-year period, was going strong when part became obsolete



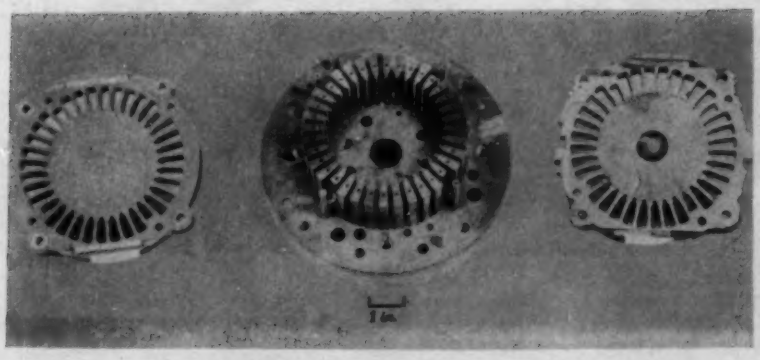
Epoxy surface plates with concrete cores, such as this one, have been used at GE's Ordnance Dept, Pittsfield, Mass, for more than 18 months. Plates consist of concrete slab about 13-in. thick, topped with 3/16-in. epoxy surface. Because plates support large weldments, concrete is reinforced with steel pipe and road bed reinforcing wire. This 8 x 5 ft plate cost about a third as much as a granite or CI same-size plate



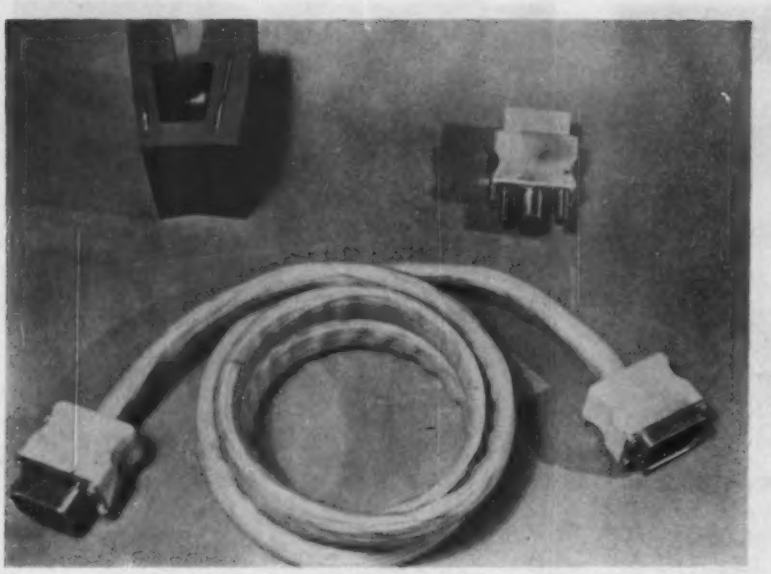
Plastic form die for stainless steel part—the 0.093-in.-thick stainless drawn part shown to right of blank was formed on a plastic die. Glass-reinforced die section (left) was made within a welded steel frame, which keeps plastic under compression during forming, eliminates possibility of tensile failure. Below is plastic punch. Upper right: stripper plate



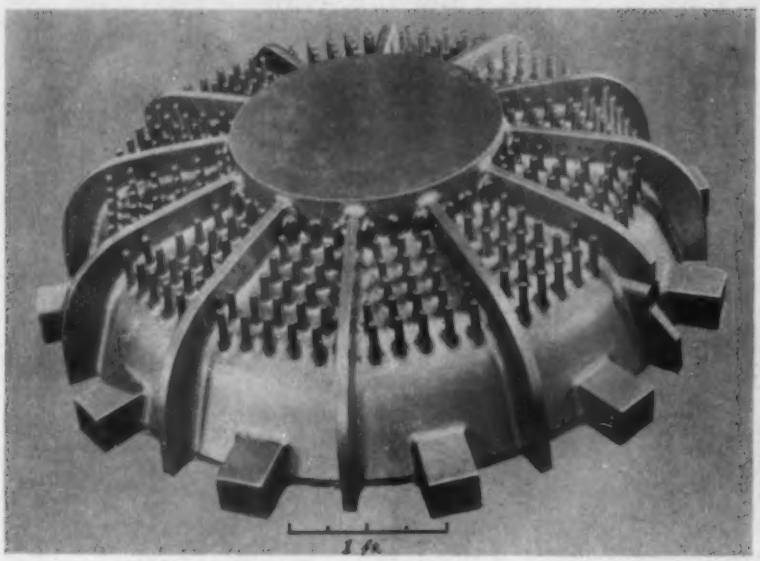
Cast epoxy engineering samples at GE's Light Military Electronics Dept—Machined aluminum casting (left) prepares RTV silicone rubber mold (center). Eight epoxy castings like one on right were produced for engineering development work at low cost, and delivery time was shortened by up to 80%



Stripper for lamination die was made by Canadian GE's Motor & Control Dept, which formulated its own material, adding a silicon carbide filler to achieve maximum stripper wear. For punch (center) thin sections were reinforced with a layer of glass cloth. Approximately 65,000 blanks were produced before the machine double-fed, causing the stripper to fail. Original steel stripper (right) cost $350: plastic stripper plate costs $50



Plastic disconnect plugs, made by the Light Military Electronics Dept, are used on cables for engineering test equipment. Cast of epoxy, they eliminate much of the hardware normally required for this kind of connection. With the connector pins and lead wires positioned in the mold, non-conductive epoxy encapsulates the wires and molds a plug shape as well. RTV flexible mold (upper left) is cut on opposite end to facilitate removing undercut portion of the plug design. Machined metal model (upper right) produces cavity in rubber mold



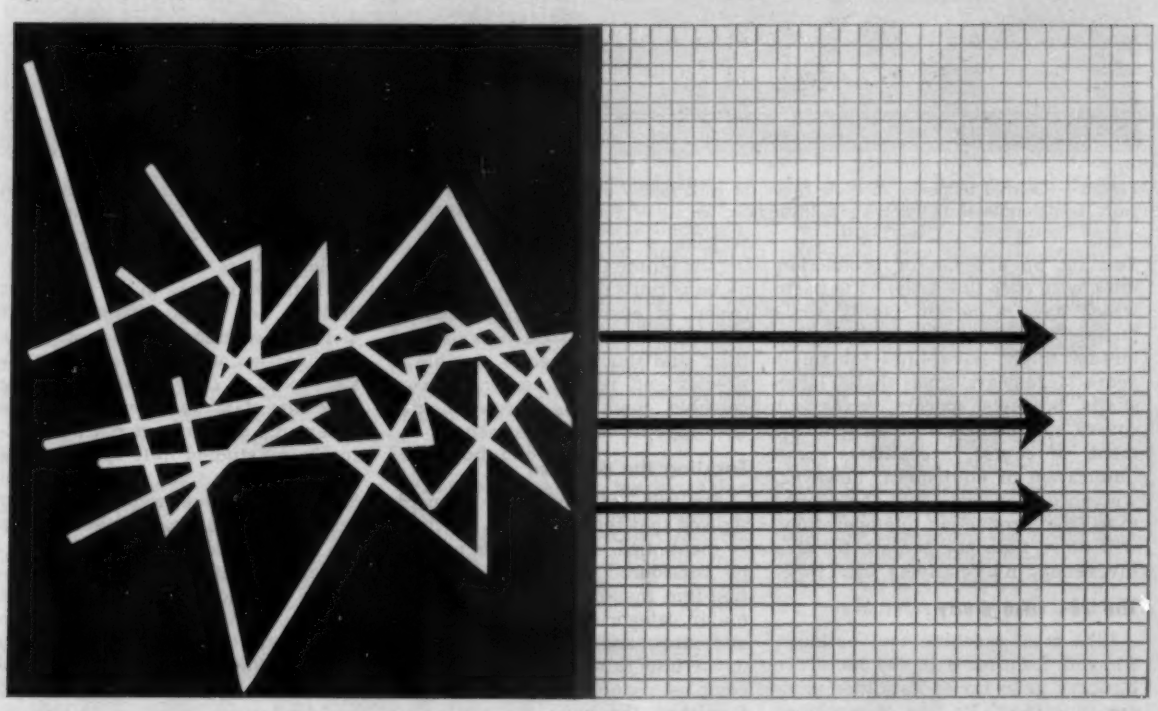
Plastic foundry pattern was made at Canadian GE's Davenport Works, Toronto. Section of pattern containing pins was made in separate flexible mold to facilitate replacement of damaged pins. Savings on this pattern: $500

Epoxy plastic nameplates were developed by GE's Computer Dept. at Phoenix. Low-cost RTV flexible molds (left) are made from a metal master (center). Epoxy nameplates can be cast in limited runs for about one-quarter the cost of die-cast plates. One of the two finished epoxy plate (right) is copper plated to resemble the original metal product

Operations Research shows how to

Machine job lots on production lines

By A O Putnam, Director of Research, Rath & Strong, Inc, Management Consultants, Boston, Mass



Jones & Lamson estimates it can save $300,000 a year by doing most of its job-shop operations on a production line, thereby slashing work-in-progress backlog requirements. Rath and Strong figured out how to set up a series of production lines—each producing parts with "family similarities"—and then demonstrated that it would work by "playing a game." This operations research technique, called Monte Carlo game analysis, proves that production line manufacture of small-lot-size parts is feasible.

American Machinist / *Metalworking Manufacturing*

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Machine tool builders—and many other equipment manufacturers—primarily do job-shop operations; they must make thousands of minor parts in very low lot quantities. Among their headaches:

- Backlogs of work in process are exceptionally high.
- Compared to metal-cutting time, setup and idle time between operations is high.
- Inspection, materials handling, and stock control add to unit costs.

Must these traditional obstacles to efficient production be accepted as inevitable? Not at all.

If management will take a "new look" approach and apply the latest in statistical engineering and "game" simulation, it can put many advantages of production-line operation into small-lot manufacture. When you combine similar operations to get the equivalent of long runs, dramatic economies result from the minimum setup time, reduced work in process, and efficiency in handling.

What is involved is a totally new concept of job-shop manufacture:

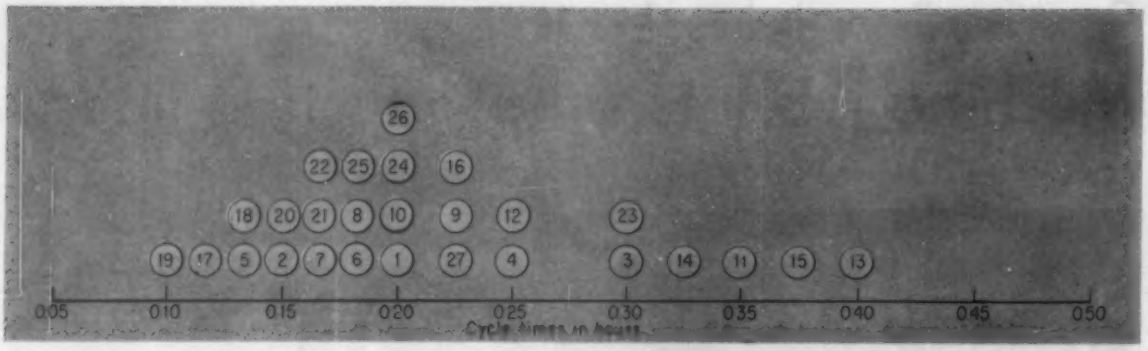


Figure 1—Central tendency of cycle times for each family of parts is determined by plotting a histogram, as above for one such family. Circled numbers refer to a particular part in the family, and show its required operating time

You set up a series of production lines, with each line assigned to parts which have a certain family similarity. For example, a machine tool builder might have lines for small gears, large gears, small shafts, large shafts, brackets, spacers, boxes and covers, and the like. Such an arrangement, of course, necessitates some duplication of equipment; however, we can demonstrate that the economies from production line operations will more than compensate for this investment in a relatively short time.

The J&L case study

Like most machine tool builders, Jones & Lamson is in the job-order business in so far as its minor parts are concerned: Its line of machines currently needs some 15,000 active minor parts. These have been manufactured in traditional job machine shop fashion, with departments arranged by processes and operations —some of them necessarily scattered —and with parts transported from one to the other. Even with the best production control and scheduling techniques, J&L (like most plants of this type) knew that a job, on the average, is assigned to a machine only one-fifth of the time while it is in process, and that even when it is on a machine, only 50% of the time is spent in removing metal. In other words, parts in process are being worked on only 10% of the time. Obviously, the challenge was to find a way to reduce setup time and to keep machines operating more.

Heretofore, this has been done in job shops only with large runs in spite of low usage, with resultant increases in inventory and related carrying charges, obsolescence risks, and other costs. We devised a way to manufacture these parts *as needed* on a production line basis, and then proved that it would work by playing the Monte Carlo game. This technique permits detailed simulation, on paper, of operations that occur in the unpredictable sequences of "real life," and thus makes it possible to predict end results under all conceivable conditions before making new layouts and investment.

Tackling the problem

Analysis of inventory records showed that there were, as previously mentioned, 15,000 minor parts to be considered for possible production-line manufacturing. We set up major categories, such as cast iron and steel, and further broke them down into sub-groups — simple or complex, round, flat, gears, etc. These furnished the basis for setting up production lines.

The Monte Carlo game was then played for hypothetical (but realistic) variations in setup and run times for each operation in a given line through which a number of parts in a given family would pass. In this way it was established before developing the Monte Carlo approach in detail, that cycle-time variations in the range of ten to one could be accepted for a given operation (between individual parts in a given category) without the creation of unmanageable bottlenecks of work-in-progress backlog between operations. (Parts varying beyond these limits would be assigned to a special machining department or incorporated into another line.)

Further, we found from our preliminary that the work-in-process backlog could be kept much lower than normal in job-shop work.

From families to lines

The parts categories, which we described above, were further classified by size: for example, shafts of 2-in. outside diameter and under 18 in. long. Since there were no existing lists conforming to the categories desired, and engineering drawings were not referenced to permit quick classification, we went straight to the stockroom to develop the lists. The necessary data was then taken from blueprints and process routings. Actually, we studied 7,010 specific parts —46.8% of the total. Of these, about 5,600, or 80%, met requirements for line production. In addition, 2% of the parts could be routed or redesigned so that they could be completed in another department. The balance, or 18%, would not fit into line production because of design complications, variations in the time elements beyond the stipulated 10 to 1 for a given operation, or because they required a special machine, such as a jig borer. These parts were put in the special machine category.

The next step was essentially trial-and-error procedure. From the blueprints and process routings we had to decide the necessary sequence of machines on individual production lines. Numerous combinations were tried on paper to see how the parts, as sorted, would adapt to lines.

During this process, many of the parts were analyzed for possible engineering changes, changes in operational sequence, or machine-tool assignment. Through this approach, many additional parts could be adapted to suggested lines.

Variation limits

Because we knew the importance of scheduling smoothness—without bottlenecks at some points or idle machine time caused by running out of work at others—we studied the time variations for all parts as soon as they were assigned to a specific line. The next step, at this stage in our analysis, was to make a cycle-time histogram for each operation on

each line (Fig. 1 shows a typical histogram). In these cycle-time histograms we disregarded setup times, because we knew that they would be changed and reduced substantially from those on operation sheets.

From the histograms we can see any central tendency of time variations (for parts in each operation). They generally fall into a normal distribution pattern. Therefore, after the first 10 or 15 parts in an operation are plotted, a median time value and preliminary acceptance limits can be set. Any parts outside the 10 to 1 ratio for upper and lower limits are earmarked for routing to special machining, or to another line. (In Fig. 1, for example, we include most parts by setting upper limit at 0.40 hr and lower limit at 0.04.)

Peculiar parts

If a part required special operations, such as cross holes in shafts or keyways, oil grooving, splining, etc, we asked the following questions:

- Can the part be redesigned to fit the line?
- Can the operation be tooled into a standard line?
- Can the operation be postponed to the end of the line?

If none of the above were practical, we started a supplementary histogram on the special operation, to see if enough parts justified this operation on a standard line.

Obviously, the lines set up at this stage were ideal: The great majority of parts required an operation on every machine in the line. However, we quickly saw, on this first go-around, that too many lines had been proposed and that they would not be loaded properly. To achieve an acceptable balance between variations in operation, we combined some partially loaded machines under one operator, and scheduled others to relieve work requirements of adjacent lines. We finally decided that 19 lines would give the best balance.

Our layout for these 19 lines, plus the finishing lines after heat treat, was made to give the least possible combining or crossing of lines for under-capacity machines. It also aided in the calculation of manpower requirements. The layout was then fitted into the building space at our disposal. (See Figures 2 and 3.)

Setup reduction

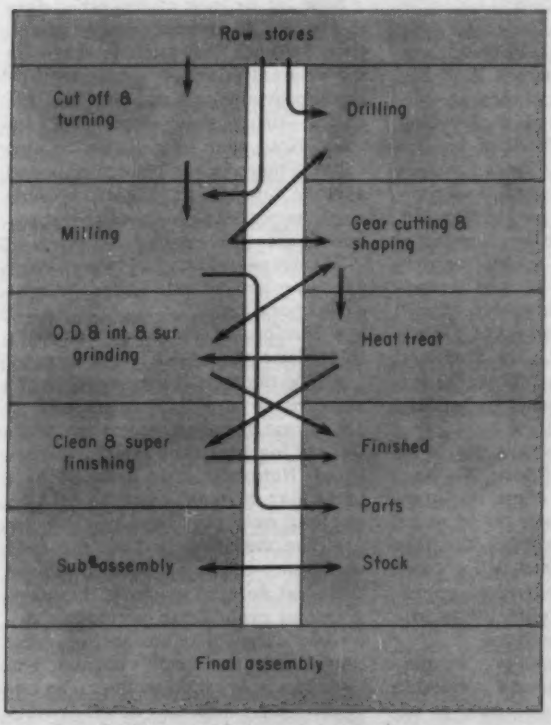
From our analysis, we estimated that J&L would reduce setups by approximately 45%, because services would be better, and individual machine requirements would be less varied. A timestudy, which was conducted on a shop run under simulated line conditions, verified our estimate.

After analyzing all general setup procedures, we developed several other timesavers:

- Floating tables for positioning give the versatility of a radial drill.
- A universal vise can eliminate changeover time. This vise is to have jaws, an angle plate, known reference points, V-grooves, and a flat surface with T-slots.
- Methods and tools were devised for quick change. We also provided means to have these tools, once in the square or hex, located from a known reference point.
- Numerically controlled turret lathes can give setup reductions.

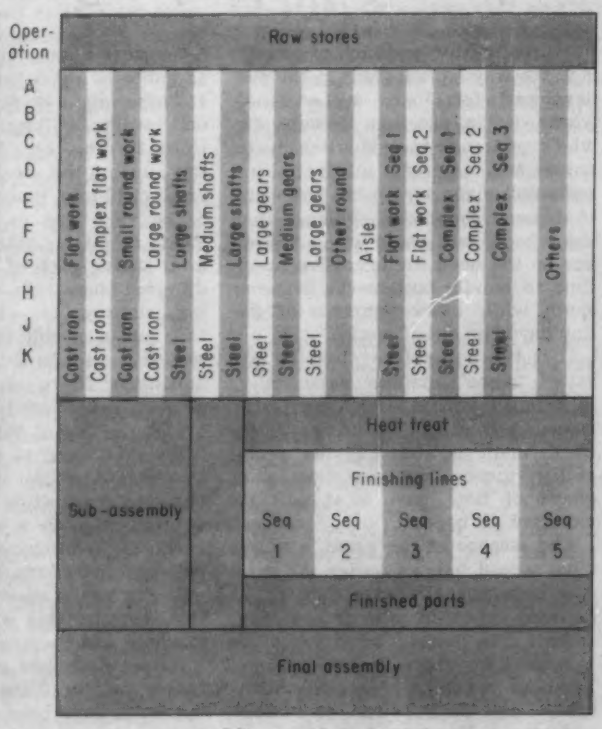
We realized that additional equipment would be needed, and that certain present machines would not be used. To determine equipment requirements, we ran a statistical analysis of the 5600-part sample and arrived at the total standard machine hours required. These requirements could then be translated into machines needed for each line.

Even at the expense of additional machines, however, we made sure that layouts minimized crossing between lines in preference to combining work onto a common machine.



Existing departmental layout

Figure 2—Existing departmental layout shows uneconomical flow pattern required in job-shop operation at J&L



After rearrangement

Figure 3—After rearrangement, the same space is used to better advantage because production lines have been set up

OPERATION	AVG TIME PER JOB (HRS)	NUMBER OF MACHINES	NUMBER OF MEN	VARIATION LIMITS PER JOB (HRS)	ADJ AVG TIME, (HRS)	TIME (SELECTED AT RANDOM) TO PERFORM EACH JOB										% VARIATION IN ACTUAL VS. ESTIMATED TIME $\left(\frac{H-L}{A} \times 100\right)$
						Job 1	Job 2	Job 3	Job 4	Job 5	Job 6	Job 7	Job 8	Job 9	Job 10	
A	5.0	2	1	0–10	5.0	4.0	5.0	0	4.5	6.0	0	0	7.5	3.0	0	150
B	10.0	4	2	0–20	8.0	11.0	9.0	10.0	18.0	10.0	0	9.0	11.0	10.0	0	180
C	7.5	3	2	0–15	5.25	0	9.0	0	6.75	6.0	5.25	6.0	0	8.25	0	240
D	2.5	1	1/2	0–5	2.0	2.75	2.25	0	0	1.0	2.75	1.75	2.25	1.5	2.75	110
E	4.0	1 1/2	1	0–8	2.4	0	0	0	5.2	0	4.8	4.8	2.0	4.8	3.2	120
F	6.0	2 1/2	1 1/2	0–12	4.8	0	4.8	9.0	9.0	7.2	4.8	0	3.6	7.8	7.8	150
G	5.0	2	1	0–10	5.0	5.0	4.0	5.5	4.5	4.5	4.5	6.0	5.0	4.5	5.0	40
H	2.5	1	2/3	0–5	1.75	0	2.75	2.25	0	1.75	0	3.75	3.25	3.0	1.0	150
I	3.0	1 1/2	2/3	0–6	3.0	2.7	3.9	3.0	1.8	1.8	2.1	0	2.4	2.9	2.3	65
K	4.0	1 1/2	1	0–8	4.0	4.8	6.0	1.6	3.6	1.6	4.8	1.6	4.4	2.8	3.2	110
NEW SEQUENCE (Job Number in Fig. 5)						6	9	4	1	10	2	5	8	3	7	

Figure 4—Typical production line has ten operations (A through K). Ten jobs, scheduled for the week under consideration, are to be lined up in best order. Their high and low operating times are indicated by colored and black boxes

For proof, we play a game

The proof of the pudding, of course, is in the way a plan—such as the one developed for Jones & Lamson—works out in practice. Because the whole approach is revolutionary in nature and requires a substantial investment, management has the right to demand conclusive evidence that the scheme will work without jam-ups or the need for excessive overtime to handle bottlenecks in some spots, while other segments of the line have run out of work.

It is here, therefore, that the so-called "game" analysis (specifically, a detailed Monte Carlo analysis) comes into play. By using Monte Carlo methods and applying probability theory, we can determine, *ahead of time*, just what will be expected to happen.

The essence of the game is to see what would happen *under the random sequence of events that would have to be coped with in real life*, rather than basing conclusions on hypothetical, theoretical situations. Although we apply some probability theory, the analysis can be readily understood. Now we shall follow an example through in detail, to illustrate the method.

Consider a line with 10 operations, as indicated by A through K in Fig. 4. These might be first turning, second turning, drilling, rough grinding, third turning, etc. Further assume that, during the week under consideration, 10 jobs (specific lots of parts to be run) are to be turned out. These might be different lengths of 2-in. shafts, each of which requires different operations—such as threading, slotting, etc.—but which still falls into a specific family of parts—say, those shafts 2-in. in diameter, and under 18 in. long. These 10 lots of parts (jobs) are listed by number across the top of Fig. 4.

We now want to select the order in which to run the 10 jobs. We want to queue them (line them up in sequence) in such a way as to avoid excessive in-progress work backlogs between operations, but still not run out of work on an individual operation, because this would cause idle machine and operator time.

As we described earlier, the machines on the lines and available operators have been balanced as effectively as possible, and partially loaded machines have been combined under one operator. Also, an operator may be temporarily assigned from one line to another.

Now let us look at the other data in Fig. 4. The average setup and run time for each operation is based on the original analysis—with any setup improvements estimated and included—using the established lot sizes. Note that in addition to this column there is one headed adjusted average time. Its nature will become clear as we explain how the simulated times are entered.

The three columns between average time and adjusted time list, for each operation:

- Number of machines necessary to perform the specific operation.
- The number of men that will be required to run these machines.

(Note that, for some operations, fractions of machines and men have been listed. Naturally, this means that a particular man or machine will be working only part time.)

- The variation in time for each operation—based on established lot sizes and determined from the histograms of cycle times previously described. The distributions of cycle times were practically normal, and the average is taken as the mean between the extreme cutoff points. The ranges are shown from zero to the upper limit; actually, the lower cutoff point is not zero, since these

OPERATION NUMBER	INITIAL WORK-IN-PROGRESS BACKLOG (HRS)	ADJUSTED AVERAGE TIME PER JOB (HRS)	Job 1		Job 2		Job 3		Job 4		Job 5		Job 6		Job 7		Job 8		Job 9		Job 10	
			TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG	TIME FOR JOB	BACK-LOG
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	(10)	8.0	18.0	20.0 △	0	12.0	10.0	14.0	10.0	16.0	9.0	17.0	11.0	29.0	0	12.0	11.0	18.0	9.0	16.0	10.0	18.0
C	[illegible]	[illegible]	[illegible]	11.5	[illegible]	11.5	[illegible]	14.5 △	[illegible]	9.25	[illegible]	10.0	[illegible]	(4.75)	[illegible]	10.0	[illegible]	4.75	[illegible]	8.5	[illegible]	9.25
D	△10	2.0	0	8.0	2.25	8.25	1.5	7.75	0	5.75	1.75	(5.5)	2.75	6.25	2.75	7.0	2.25	7.25	2.75	8.0	1.0	7.0
E	(10)	[illegible]	[illegible]	12.8	[illegible]	16.4	[illegible]	18.8 △	[illegible]	16.4	[illegible]	10.8	[illegible]	16.4	[illegible]	17.2	[illegible]	16.8	[illegible]	14.4	[illegible]	12.8
F	(10)	4.8	9.0	14.2	4.8	14.2	7.8	17.2	9.0	21.4 △	0	16.6	0	11.8	7.8	14.8	3.6	13.6	4.8	13.6	7.2	16.0
G	[illegible]	[illegible]	[illegible]	9.5	[illegible]	9.0	[illegible]	(8.5)	[illegible]	9.0	[illegible]	10.0	[illegible]	10.8	[illegible]	10.0	[illegible]	10.0 △	[illegible]	9.0	[illegible]	8.5
H	10	1.75	0	8.25	0	(5.50)	3.0	7.75	2.25	8.25	3.75	10.25 △	0	8.5	1.0	7.75	3.25	9.25	2.75	10.25	1.75	10.25
I	[illegible]	[illegible]	[illegible]	8.8	[illegible]	(7.9)	[illegible]	8.8	[illegible]	8.8	[illegible]	10.0	[illegible]	9.7	[illegible]	10.0	[illegible]	9.4	[illegible]	10.3 △	[illegible]	9.1
K	10	4.0	3.6	9.6	4.8	10.4 △	2.8	9.2	1.6	6.8	1.6	4.4	4.8	5.2	3.2	4.4	4.4	6.8	6.0	6.8	1.6	(4.8)

○ *Lowest work-in-progress backlog* △ *Highest work-in-progress backlog*

Figure 5—After the jobs have been rearranged, their work-in-progress backlog is studied. Colored bands mark the backlog position of each operation after any given job has been finished and moved on to next operation

are all averages of actual values. In Operation C, for example, the time may be anything from some small amount to 15 hours for any one lot.

Simulating "real life"

In playing the game on paper, we do not know just which 10 parts might come up for scheduling in any particular week; therefore, we assume that the parts will come up at random. To make the chart reflect what *could* happen in real life, we first enter a setup and run time for each operation (shown in Fig. 4). These are taken from a statistician's table of random numbers for a normal distribution (which the histograms—studied earlier—told us we could assume), between the known variation limits for each operation (shown in Fig. 4). Their average times are entered in the second column. Including the zero entries, which will be explained immediately, the chart at this point represents a lineup of 10 conceivable jobs for this particular line, presented to the scheduler as they would come up in the course of a week's work.

Now, *about the zeros*, which were substituted for certain of the random numbers. It should be recalled from our previous discussion that the original "ideal" line (where all parts called for all operations) had to be somewhat compromised to secure adequate loading. This means that on the lines we finally established, some parts will be assigned which do not call for any operations on certain machines. To make our game conform to the lines as finally established, we must consider this.

Analysis has shown that on this particular line under consideration, the total number of missing operations for all parts will not exceed 20%, with some parts having as few as six operations on the line, but with no part missing more than four.

In Fig. 4, we have substituted zero times for some of the random numbers. We assume that 20 zeros (corresponding to 20% of 10 jobs and 10 operations) are to be scattered about in some way so that no one column (specific lot of parts) has more than four zeros. This can be done by throwing dice, shuffling numbered cards, or in other ways to assure random assignment.

The average times for the horizontal lines (the 10 operations) are now adjusted to take into account the zeros. This works out, arithmetically, to simply taking the ratio of the surviving operations to the original ten, and multiplying the average by that ratio. (For example: In line A there are four zeros. Therefore, we have a ratio of .6 which, when multiplied by the original average time of 5.0, gives us an adjusted average time of 3.0.) Operations G, J, and K, of course, remain unaffected because they have no zeros.

It should be mentioned here that we are going through this elaborate analysis to demonstrate that the scheduling will work. In actual practice, of course, *once the method has been established, the scheduler need do nothing more than the queueing*, or sequencing, which will now be explained.

High-low sequencing

As we mentioned earlier, we are doing all of this to find out the best order in which to run the 10 jobs during a week. In this example, we are going to use a rather simplified sequencing arrangement, the results of which are shown in the bottom horizontal line in Fig. 4.

Here's what we do, in theory: *First*, run the job which has the highest time for some specific operation (relative to the mean time for that operation), and *second*, run the job which has the lowest time for that same operation. Next, a job which has the highest time for another operation is followed by a fourth job having the lowest time for *that* operation. The assignment alternates in that fashion.

END POSITIONS

Operation	Gain (Loss) of Work-in-Progress Backlog (hrs)	Operating Time (hrs)	% Over (under) Original 10-hr Estimate (Gain ÷ op. Time)
A	5.0	30	17%
B	8.0	80	10%
C	(-0.75)	52.5	(-1%)
D	(-3.0)	20	(-15%)
E	2.0	24	8%
F	6.0	48	12%
G	(-1.5)	50	(-3%)
H	0.25	17.5	1%
J	(-0.9)	30	(-3%)
K	(-5.6)	40	(-14%)

Figure 6—For each operation, the gain (or loss) of work-in-progress over 10-hour estimate is expressed as a percentage

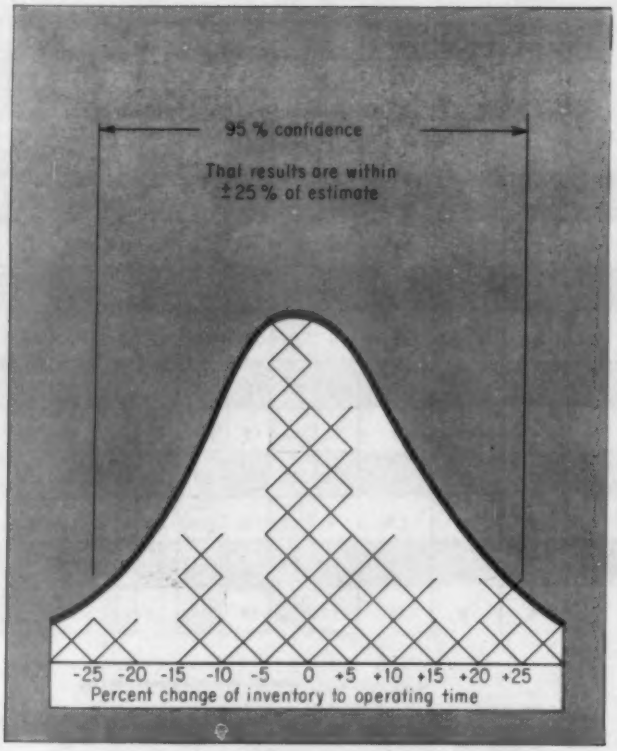

95 % confidence
That results are within
±25 % of estimate
-25 -20 -15 -10 -5 0 +5 +10 +15 +20 +25
Percent change of inventory to operating time

Figure 7—Plot of backlog positions shows that we have 95% confidence that results are at least 25% of estimate

RANGE OF WORK-IN-PROGRESS BACKLOG

Operation	High (Hrs)	Low (Hrs)	Range (Spread) (Hrs)	Number of Men	Range Per Man (Hrs)
A	5.0	-4.5	9.5	1	9.5
B	10.0	0	10.0	2	5.0
C	4.5	-5.25	9.75	2	4.9
D	0	-4.5	4.5	1/2	9.0
E	8.0	0	8.0	1	8.0
F	11.4	0	11.4	1 1/2	7.6
G	0	-1.5	1.5	1	1.5
H	0.25	-3.5	3.75	2/3	5.5
J	0.3	-2.1	2.4	2/3	3.6
K	0.4	-5.6	6.0	1	6.0

Figure 8—Plotting the spread in backlog, we can calculate a variation or range per man for each operation

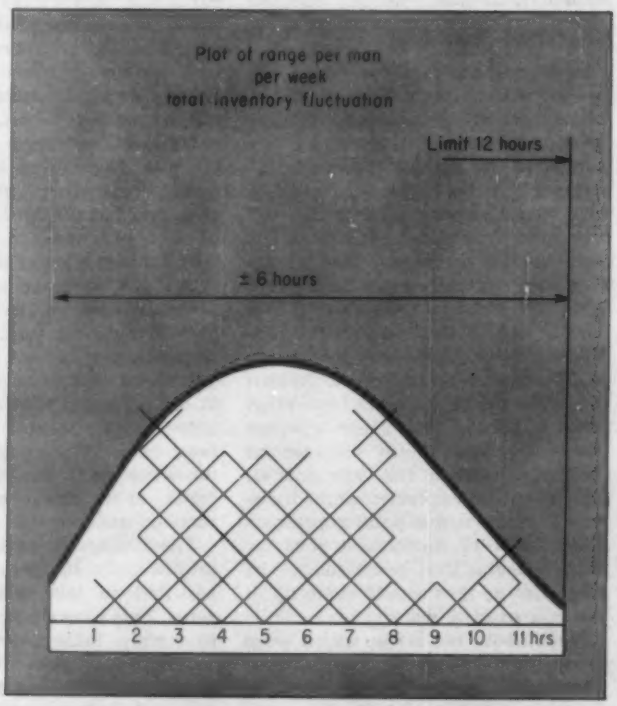


Figure 9—Plotting this backlog spread, we find we have 95% confidence that variation will be no more than 6 hours

To assist us in this selection, we have computed the right-hand column in Fig. 4. This is the ratio of variation in actual time to estimated time. To calculate it, we calculate the difference of high and low for each operation, and divide that by the average time for that operation. For example, in operation B, the high is 18.0 and the low is 0.0. Therefore, since the average time for this operation is 10.0, we find that the variation in actual operating time for operation B is 180% of estimated time. In operation J, high (4.2) minus low (1.8) is 2.4. Dividing by the estimated (average) time of 3.0, we come up with a percentage of 80.

Let us now determine the new sequence: Take the operation with the highest percentage (Operation B, with 180%). Find the job with the highest time for this operation (Job 4, with 18 hours). This becomes Job 1 under the new sequencing. (Notice that we have written a 1 under Job 4 in Fig. 4.) Then find the job with the *lowest* time for this *same operation* (Job 6 with zero hours). This becomes Job 2 in the new sequence. (It should be pointed out that Jobs 3, 7, or 10 could have been used, instead of Job 6. We would then have different, but equally valid, results.) Following this process with the operation having the next highest percentage (Operation A with 160%) gives us new Jobs 3 and 4 (old Jobs 9 and 3), and so on.

If this arranging is not done, several jobs, each having a high value for the same operation, might occur in sequence, creating a bottleneck. Or, several low operations could come in sequence, causing idle time because all of the cushion of in-process work backlog would be used.

Playing the game

The arrangement as finally sequenced is shown across the top of Fig. 5. To play the game, we assume that each operation has an initial backlog of 10 hours of work, and see what would happen. As soon as any operation on a lot of parts (a job) is completed, the next job for that same operation is taken, and so on.

As we said above, we have assumed an initial backlog of 10 hours of work for each operation. In Fig. 5, we have kept a running account of this work backlog for each operation. This is shown in the second column under each job or lot of parts (in color). Let us look at Operation A: Obviously, if Job 1 takes 4.5 hours, as indicated, and the whole arrangement has been predicted on the average time of 3 hours, then this operation on Job 1 adds 1½ hours worth of work to the 10-hour "work-in-progress backlog", making the backlog 11.5 hours, as shown in Fig. 5 under Job 1. Since Job 2 has zero time for Operation A (it doesn't call for that operation on the parts being produced in Job 2), the man on the machine "eats into" the backlog, and brings it down to 8.5 as shown. If this is followed along, it will be seen that, after Operation A has been done on all 10 jobs, we have 15, or five extra hours of backlog chalked up to that operation. This has been carried out in Fig. 5, for each of the 10 operations.

We should point out here that, in practice, the first pieces completed on any machine will probably be in operation on the following machine prior to completion of the very last piece of the fore-running operation. No attempt has been made to evaluate this additional method of cutting down work-in-progress inventory. Instead, it is a safety factor.

Analyzing the results

To determine the confidence limits of the game (and therefore of this whole production line process), we first compute the plus-or-minus position of work-in-process backlog for each operation. This is easily done.

From Fig. 5, we take the final backlog situation (the last column) and from this subtract our initial assumed backlog of 10 hours. These have been calculated for each operation, and are itemized in Fig. 6. (For example: Operation A ended up with 15 hours of backlog. Since it was assumed to have started with 10, the gain in work backlog is 5 hours. Operation D ended with only 7 hours backlog. Therefore, its gain in work-in-progress backlog is –3 hours — a reduction of three hours.

The next column in Fig. 6 shows the estimated operating time for each operation. It is simply the adjusted average time per job multiplied by the 10 jobs which were run.

In the right-hand column of Fig. 6, we have calculated, for each operation, the percentage of time over or under the estimated time that the operation actually took. Operation A took 5 hours extra, which, based on an estimated time of 30 hours, is an excess of 17% ($5 \div 30 = 0.17$). This is calculated for each operation, with the minus sign indicating a reduction of work-in-progress backlog.

Fig. 7 shows these percentages—plus others taken from similar analyses so that we have enough for a reliable statistical analysis—plotted on a histogram. We have assumed (and all results confirm that this is a valid assumption) that these percentages will fall into a normal distribution. Therefore, we can see that 95% of the time (those results falling within plus or minus two standard deviations) end results are within 25% of expected operating time.

In terms of our situation, this means that only one time in 40 would the end positions vary more than plus 25 percent, or 10 hours (25% of a normal 40-hour week). Thus, it would be quite safe to count on overtime for no more than 10 hours per week. (Of course, by the same token, if we have a starting work-in-progress backlog of 10 hours, one time in 40 this time between operations will be reduced to zero.)

These results are satisfactory within the original goal: In any 40-hour week, we need no more than 10 extra hours for reducing bottlenecks. And, with proper advance scheduling, these end positions will be predicted in advance, and the overloaded operations can be reduced by one or two extra hours per day. Also, the scheduler will consider any low inventory operations at the end of the week, and plan to run jobs that bring these positions back to average.

Weekly high-low backlog

All our results so far have been estimated on the assumption that we are starting with a 10-hour work-in-progress backlog on each operation. Is this enough? Is it too much? Let us take a look and see if this figure could be cut down.

The first thing we do is to calculate in Fig. 8 the high and low positions (around the original 10-hour backlog for each operation) that each operation occupies during a weekly cycle. This is easily done from Fig. 5. The high point of work backlog for operation A was its end-point — 15 hours. This, since we started with a 10-hour backlog, represents a 5-hour increase. Therefore, we have entered 5 hours as the high for operation A in Fig. 8. Operation F reached a high of 21.4 hours backlog after Job 4 was run; therefore, its high point of work-in-progress backlog is 11.4 (21.4 –10), and this figure has been entered in Fig. 8.

In the same manner, we get the low points. Operation A dropped to 5.5 hours of backlog after Operation 7; therefore, its low point of backlog is 4.5 (10.0—5.5). In the same manner, Operation E never got below its 10-hour starting point in work-in-

process backlog; therefore, its low point (represented by original backlog), is zero (10 – 10).

After calculating the high and low points for each operation, we figure out a range, or time spread, for each operation. This is done by adding together the high and low for each operation (irrespective of sign); it tells us the amount of variation of work-in-progress backlog that each operation has during the week. It can be seen that operation A has a spread of 9.5 hours (high of 5.0 + low of 4.5); Operation E has a spread of 8.8 hr (high of 8.8 + low of 0).

After this spread in hours has been computed, we take one more step. We divide each range (spread) by the number of men assigned to work on that operation (shown in Fig. 4 and repeated in Fig. 8) to get a common basis (range per man) on which we can compare the operations.

Quite a reduction

As we did in the previous case, we make a histogram to analyze these (and similar) results (see Fig. 9). This tells us (again assuming a normal distribution) that we can have 95% confidence that the variation will be no more than 6 hours in either direction. Thus, not even 10 hours of work-in-progress backlog would be required at the start.

An average of 8 hours per man of work-in-process between stations (8 hours at the start, in our game) should be sufficient to prevent idle time. And the bottlenecks (which require considerable extra work hours) should not exceed 14 (8 plus 6) more than once in 20 times.

This 8 hours of work-in-process backlog between operations compares very favorably indeed with the 32- to 40-hour average required by many large job shops at the present time!

And in practice, there are additional safeguards that can help in scheduling these lines. If, for example, a particularly big job is going to build a bottleneck in one place, or use up inventory in another, we can split it up into ½-lot runs in successive weeks. In addition, there is the "safety factor" already mentioned: With this production line operation, it will be possible to run parts on succeeding operations as they are ready, rather than waiting to complete and move the whole lot.

What this means in dollars and cents

All this sounds interesting. But what, you say, does this mean in terms of operating economies? What is the dollars-and-cents stake? There are many savings:

- First, the reduction of work-in-process inventory will, *in the first year,* cover most of the additional investment in equipment and tools, which Jones & Lamson has estimated at about $400,000.
- Second, there will be a sizeable saving in total setup costs.

Other savings

There will be savings in other areas, also, although they are not so important as the two listed above. And, when considered as a group, these add up to a significant figure:

- **Materials handling.** Because machines are closer together, trucking can be reduced considerably
- **Industrial engineering.** Group leaders and foremen have more contact with the actual machines, since they can be assigned to a line or series of lines. Therefore, some of the servicing work of the time study department can be eliminated.
- **Quality control.** The only inspection of parts by the quality control department will be at the end of each line. All prior checks can be made by the foreman or group leader, who will call on the experts only when questions arise.
- **Timekeeping.** Timekeeping by operation is not required under this new system. Only a man's line, his clock number, and date are required.
- **Accounting and data processing.** If a standard cost system is used, much posting and detailed reporting may be eliminated. Actual hours can be derived from standard hours—modified by the performance of the line and tempered by a variance factor for non-standard conditions.

Any drawbacks?

There will, of course, be offsetting capital charges and operating costs. Investment in equipment, tooling, racks, etc., has already been mentioned. In the J&L study, these were estimated at $400,000 but this can be offset by reductions in inventory. In addition, there will be changeover costs: estimated at J&L to be approximately $250,000. For example, the methods department must go over all processes to bring them up to date in the line concept. Time study must re-evaluate standards based upon line reduction of setup times, and construct charts to aid in rate setting.

New approaches in the training of personnel will be necessary in the cost and payroll department as well as in production control. It will be necessary to train supervision and staff personnel, group leaders and, in some cases, direct labor.

However, the net result is in the black, and the return on investment should be substantial. In our study, even the most conservative estimate shows that potential savings would pay for the change-over cost after one full year of operation and should net in excess of $300,000 annually after that. This figure can't be laughed at, even if it does mean playing a game to get it.

AUTHOR'S NOTE: This project involved a team of Robert Jones, General Manager, Raymond Streeter, Factory Manager, and Walter Sinauski, Manufacturing Engineer, of Jones & Lamson Co; and J Henry Parker, Vice President, William Kendig, Consultant, and A O Putnam, Director of Research, of Rath & Strong, Inc

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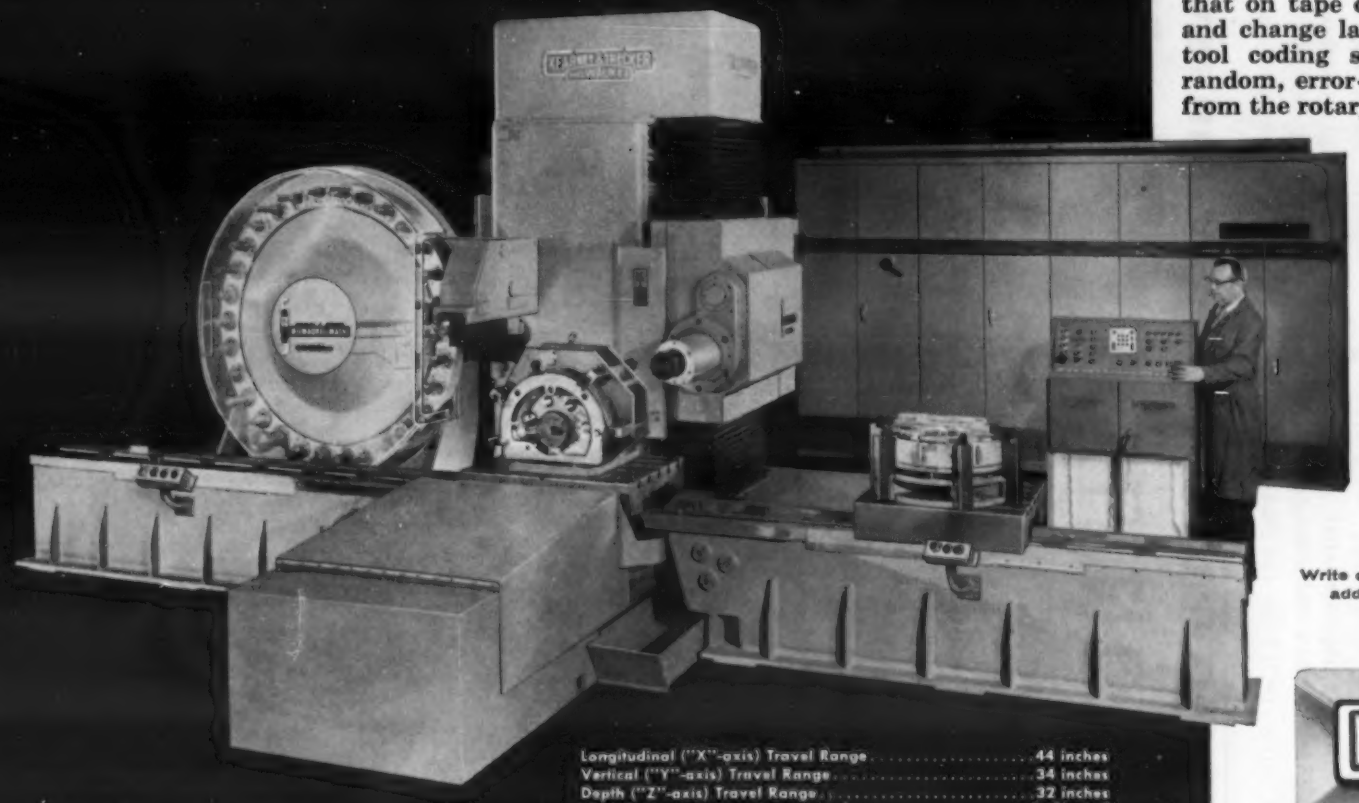

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Screw Machine Work on Aluminum—I

By M Bryan Baker. Kaiser Aluminum & Chemical Corp, Oakland, Calif.

Source: Revised edition of "Machining Kaiser Aluminum With Automatic Screw Machines"

Trouble Chart for Single-Point, Flat and Circular Form Tools

Possible Causes	Corrections
Breakage	
Dull tools. Deflection of toolslides, turret or workpiece can be caused by dull tools; if other tools are engaged, they may be broken due to the sudden impact as the dull tool engages or leaves the work	Resharpen prior to excessive dulling
Improper sharpening methods can cause checking or cracking	Check sharpening methods, avoid overheating, quick cooling
Excessive feed	Reduce feed rate to enable tool to stand up under the work pressure, or revise tool design for greater strength
Rapid traverse	Reduce traverse speed that causes tools to "hog-in" or enter the metal too quickly
Shims in brazed tools, when too thick, may deflect end of carbide tip by mushrooming	Try thinner shim; excessive tool deflection may necessitate reduction of overhang and/or increase in tool support rigidity
Vibration	Be sure that machine, especially bearings, toolholders and fixtures are in first-class condition; reduce overhang and relief angles to minimum; increase rigidity (see "Chatter").
Clamping difficulty	Check holding methods to insure they do not induce stresses that can cause tool breakage when cutting
Wrong grade of carbide	Try less brittle, tougher grade. (Consult manufacturer)
Underpowered machines	Machines that will not cause slowing or hesitation of the tool or workpiece will minimize tool breakage
Intermittent coolant application	Check for worn pump, improper operation; decrease pressure so hot tool will not be subjected to sudden cooling
Inclusions, hard spots	Consult manufacturer, if excessive or consistent
Careless handling	Improper handling can cause nicks, start tool failure; use care in handling, storage; coat tools with grease when not in use
Chipping of Cutting Edge	
Excessive relief; tool jabbing	Too much relief weakens cutting edge; note recommendations
Clearances, chipbreakers improperly ground	Use clearances specified or less; see if chip breakers are smooth, carefully ground; avoid hasty additions of curlers, chip breakers
Careless handling	Check above under "Breakage"
Excessive vibration	Condition, rigidity of machine, holders and fixtures should be checked; determine if relief angles are excessive

Continued on page 171

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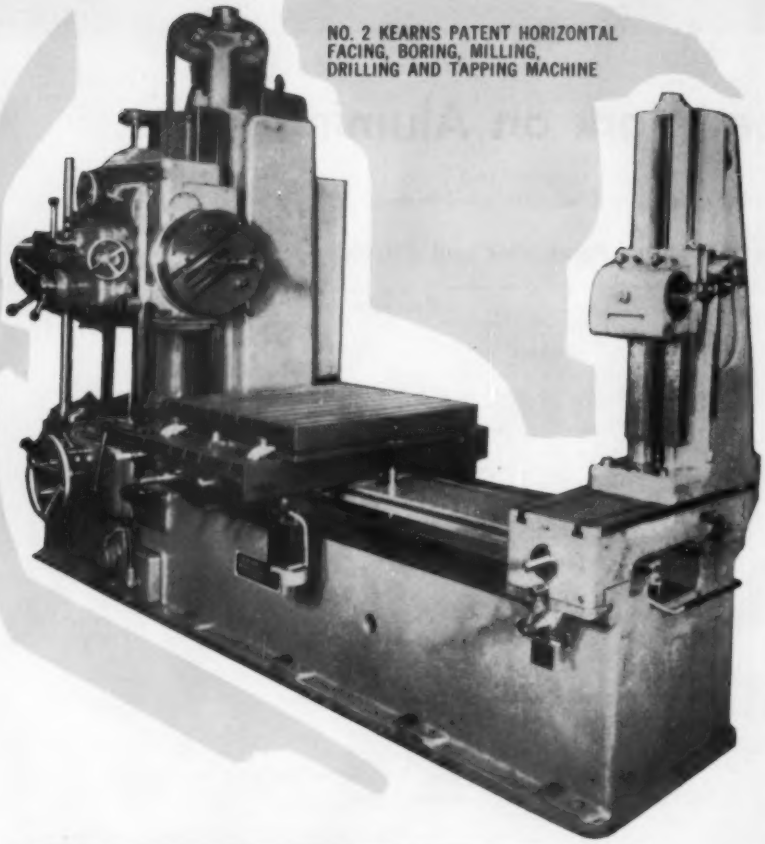

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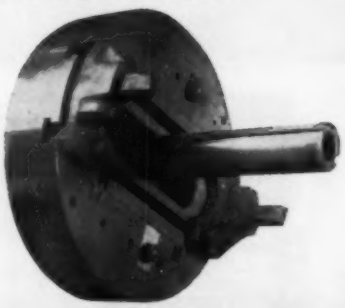

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Screw Machine Work on Aluminum—II

Trouble Chart for Single-Point, Flat, and Circular Form Tools—*Continued*

Clogging of chips can cause tools to jam against the workpiece or impair cutting action	Altering lead angle will change nature of chips—increased angle causes thinner chip, less angle a thicker one, increase coolant flow; try liquid with more coolant properties. (Refer to "Chip clogging").
Chatter	
Worn, loose spindles, bearings; lack of rigidity in setup; speed too slow; depth of cut excessive; tool angles too great	Check setup components, machine units for play; increase (occasionally decrease) speed; reduce depth of cut; decrease tool angles to those recommended, or less
Dimensional Runout	
Excessive feeds; varying depths of cut may result from bent, burred, dirty collet, sleeve, or toolholder; built-up edge on tool	Speed or feed may have to be reduced. Check for damaged or dirty collets, holders; shank should be flat, properly seated; hold-down screws should be flat-bottomed, square with tool axis; keep tools sharp, honed
Excessive Pressure	
Chip-breaker too narrow; dull tools	Wide, shallower chip-breaker indicated; check clearances, increase likely; sharpen tools before dullness becomes noticeable
Rubbing	
Relief or clearance insufficient; tool held crooked	Increase clearance or relief until tool does not rub or drag; check for proper mounting, holding
Built-up Edge on Tool	
Rough tool finish; improper or insufficient coolant	Tool surface should be honed after grinding to remove all grinding marks; if coolant or lubricant is insufficient or of wrong type, heating and consequent metal build-up will result
Burning of Cutting Edge	
Cutting fluid inadequate; excessive speed; overheating during sharpening	Direct coolant flow to cutting edge; increase flow; change to fluid having more cooling properties as well as lubrication; reduce surface speed to where tool edge is not burned; tool material of greater red-hardness may be necessary
Rough Finish	
Improper tool angles; dull tool; improper cutting fluid or insufficient flow; too high feed rates; too low surface speed; build-up on tool cutting edge	Reduce tool angles; do not allow tool to become excessively dull; try cutting fluid with more lubricating quality and/or increase surface speed; hone cutting edge
Cratering	
Rake angle insufficient; feed and/or speed too high	Higher rake angles will reduce friction of chip against tool; reduce speed and/or feed; use tool material that is more resistant to abrasion
Chip Clogging	
Cutting fluid flow insufficient; chips not broken up sufficiently	Direct flow of cutting fluid to wash away chips; increase flow and pressure; grind chip breaker or curler into tool

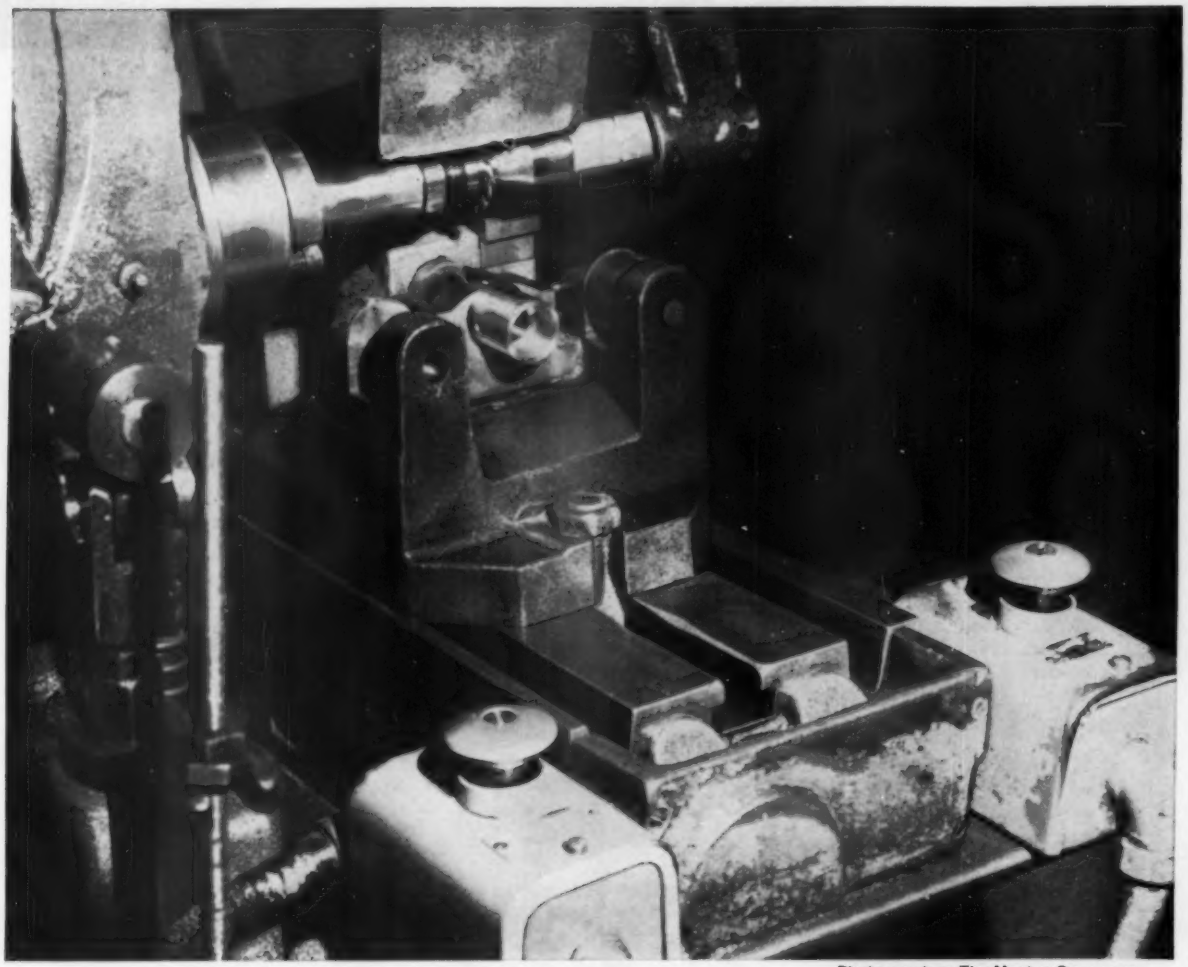


Photo courtesy The Maytag Company

Aristoloy Leaded 8620 cuts tool changes 50% on wringer drive sleeve for Maytag

Has working time been reduced? Yes.

In what way? The use of Aristoloy Leaded* has increased tool life and reduced downtime for tool changes.

Has machining been improved? Yes.

What inherent quality in the steel is responsible for improved machining? A more uniform, satisfactory microstructure provides better machining characteristics.

What operation is performed? Automatic screw machines bore, counterbore and cut off. Secondary operations include milling, drilling, internal and external grinding after carburizing.

For complete information about Aristoloy blooms, slabs, billets and bars, in carbon, alloy, stainless and leaded, call the Copperweld representative in your nearest large city—or write for NEW PRODUCTS & FACILITIES CATALOG.

*Inland Ledloy License

ARISTOLOY STEELS

DIVISION OF COPPERWELD STEEL COMPANY

ARISTOLOY STEEL DIVISION • 4009 Mahoning Ave., Warren, Ohio • EXPORT: Copperweld Steel International Co., 225 Broadway, New York 7, N. Y.

Cutting Time for Bandsaws

By Tyler Hicks, mechanical engineer

Time to cut metal with a bandsaw can be computed from

$T = L \div (12\ C \times f \times P)$

where:

L = length of cut, in.
C = cutting speed, fpm
f = feed per tooth
P = saw pitch, teeth per in.

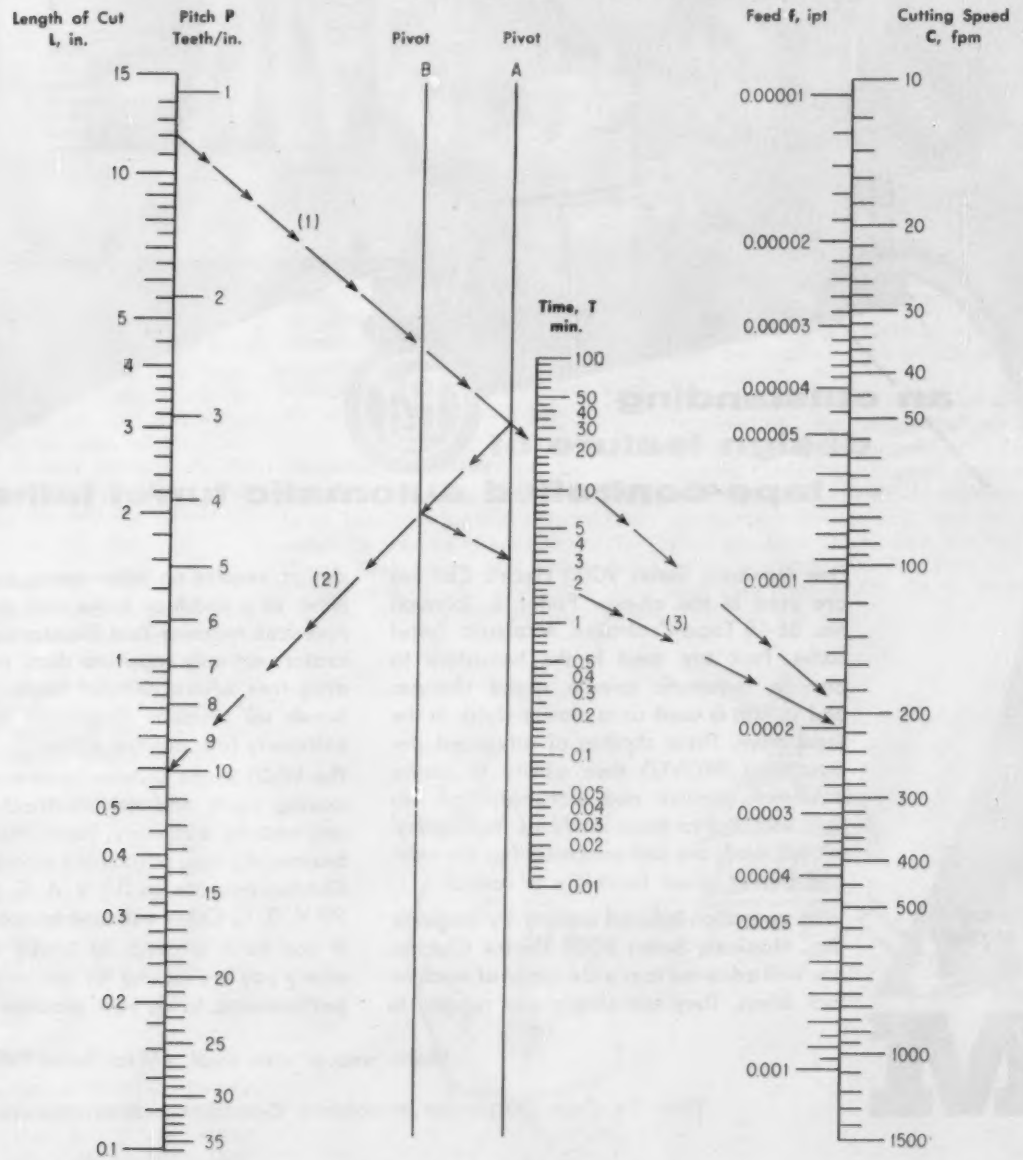
Recommended feeds and pitches for mild steel are:

Material Thickness, In.	1/16 – ⅛	¼	½	1	2 – 3
f	0.0005	0.0003	0.0002	0.0001	0.00005
P	18 – 24	14 – 18	10 – 14	6 – 14	4 – 8

PROBLEM: How much time is required to make a 12-in. cut in ½-in. plate with a 10-pitch blade and 0.0002 in. feed per tooth?

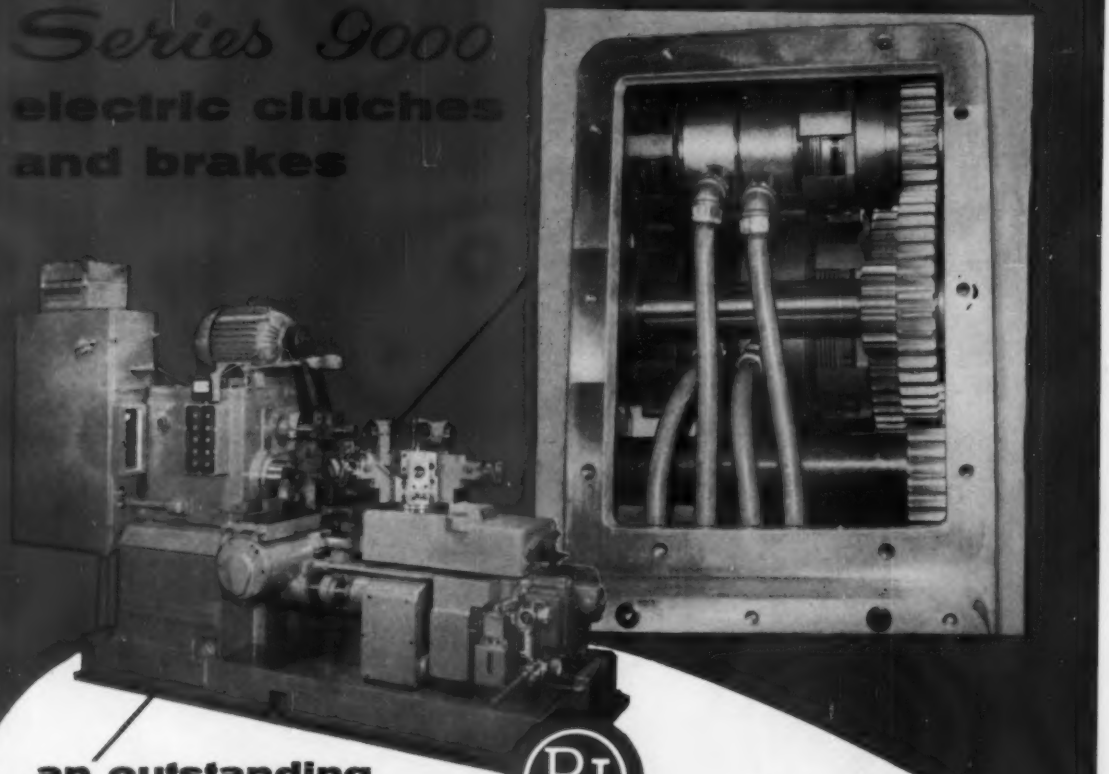
SOLUTION: Enter chart at cut length = 12 and project line (1) to cutting speed = 200 fpm. At intersection on pivot line A, project line (2) to P = 10 teeth per inch. From intersection with pivot line B project line (3) to f = 0.0002 ipt. Where line (3) cuts line T, read time = 2.5 min.

Cutting speeds for mild steel are, 1/16 in. – 250 fpm, ⅛ in. – 225, ½ in. – 190; 1 in. – 175 fpm.



Maxitorq

Series 9000 electric clutches and brakes



an outstanding design feature of tape-controlled automatic turret lathes

Five Maxitorq Series 9000 Electric Clutches are used in the all-new Potter & Johnston No. 3E-15 Tape-Controlled Automatic Turret Lathe. Four are used in the headstock to provide automatic spindle speed changes and a fifth is used as a master clutch in the feed drive. These clutches of advanced design have PROVED their ability to assure consistent, positive and extremely fast action; essential to these machines. They transmit full load, are self-compensating for wear and permit great flexibility in control.

With operation induced entirely by magnetic flux, Maxitorq Series 9000 Electric Clutches are well adapted to a wide range of machine tool drives. They are simple and rugged in design, require no adjustments, can be used *either as a clutch or brake* and are built to American Machine Tool Standards. Disc separators not only separate discs, providing a drag-free neutral without heating, but also break up residual magnetism and permit extremely fast, positive action.

The 9000 Series Clutches have a minimum of moving parts and the electrical operating unit remains stationary, hence, there are no brushes, slip rings or complex wiring. Maxitorq Clutches operate on 110 V. A. C. rectified to 90 V. D. C. Other voltages on special order.

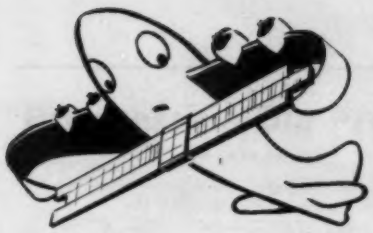
If you have a clutch or brake application where you are looking for new and improved performance, bring your problem to us.

Phone, wire or write Dept. AM for Series 9000 Bulletin.

The Carlyle Johnson Machine Company, Manchester, Conn.

3CJ59

Talking Shop



Era of Automation

A POPULAR STORY with numerical control fans concerns an airplane that took off from New York for Chicago. When the plane was in the air, an announcement came over the public address system: "Ladies and Gentlemen, this is a historic flight. This plane has no crew. It is being controlled by the very latest automatic equipment. When we reach our cruising altitude your lunch will be served automatically. This is a recorded announcement. Now sit back, relax, and enjoy your flight, secure in the knowledge that the control system is absolutely foolproof—foolproof—foolproof . . ."

Satellite Metal

THE PLASTIC BALLOON that is the Echo satellite is carried aloft in a magnesium canister. Magnesium was the principal metal in the Discoverer satellites and in some of the Vanguard and Pioneer orbiters. So the Dow Metal Products *News* has dubbed mag the satellite metal.

Casting Idea

A new approach to help people find out how to make the best use of castings has been developed by the Gray Iron Founders Society. Simple questions the Society is prepared to answer by phone or mail. Complicated situations involving casting design or possible casting design problems will be passed along, with the Society's preliminary suggestions, to Designers for Industry. The latter organization will recommend an approach and make a cost estimate. This much service is free. If you agree to continue, the proposed solution will be developed by the consulting firm.

Clamped Tools

SOMETIMES THE SAVINGS on throwaway carbides are so great as to sound ridiculous, but if you've had experience with them you know they can be true. The latest is reported by Aerojet General at Azusa, Calif. In a single-point threading operation on a 6.625-in.-dia part of SAE 4130 steel, hardened to more than 180,000 psi tensile, brazed-tip tools had to be ground after threading two parts on a Warner & Swasey 2A. Time for tool changes and regrinds for 12 pieces cost $10. With a triangular insert, 12 pieces can be threaded by using three cutting points. Cost of time to index the tool points: 15c. The tool was Kennametal K4H, has a special clamp that permits moving the insert forward until it is snug against the recess shoulders. Indexing can thus be done without resetting the stops.

Rubber Bushings

SOME OF THE NEW synthetic fibers are hard on textile machinery. Glass fibers are probably hardest of all. Glass dust grinds its way into bearings. Solution to this problem on one new machine is bushings made of urethane rubber. The bearings are abrasion resistant, and when they do wear they are easier to replace than the press-fit metal bushings.

Tungsten Extrusion

TUNGSTEN, with its 6170 F melting point, is an inviting and a frustrating metal. In a series of tests at the National Aeronautics and Space Administration, an 8:1 reduction was the best that could be obtained with a standard extrusion press at 150 ipm. This required a columbium jacket and a lubricant of powdered glass and graphite. With high-energy Dynapak forming, reductions of 45:1 were obtained, according to Convair. No lubricant was used and the working temperature could range from 3000 F to 3800 F. High-velocity forming makes smaller crystals, with corresponding ductility increase.

Pressure Groups

"GOVERNMENT TOUCHES intimately almost every one of our activities, and organizations of every sort have legislative committees whose duty it is to follow proposed legislation and keep their groups informed, or to suggest new legislation. Such groups, frequently designated as pressure groups, are invaluable. No legislator can be adequately informed about the great multitude of highly specialized problems upon which he must pass, and it is up to those of us who have the facts to see that they are made known to our representatives."

That quote is from a new booklet, *"Citizenship and Participation in Public Affairs,"* published by the Engineers' Council for Professional Development. It starts with a statement by Herbert Hoover and goes on to give practical suggestions for individual participation. The booklet is available from ECPD, 29 W 39 St, NYC, for 25c.

Practical Ideas

Bench Clipper is Handy Shop Tool

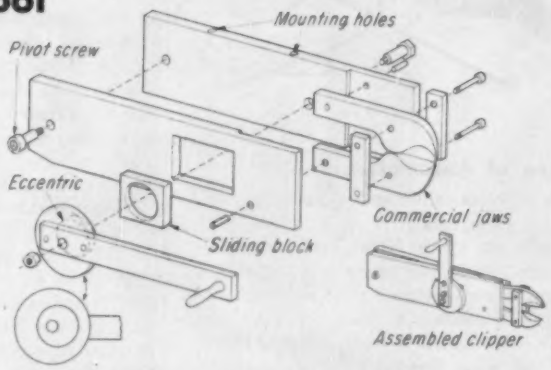
A tool that is always ready for use, not one that has to be picked up and later put back, is definitely a time saver. The bench clipper shown is such a tool. Mounted on a bench or other solid foundation, it leaves one hand free and stands ready to sever flat strip or rod stock to lengths desired.

Utilizing a set of commercial jaws from a pair of No. 14 H K Porter hand bolt clippers simplifies construction considerably. The remainder of the tool is, for the most part, made up of CR steel. Two ⅝-in. plates, 2½ in. wide and 9¼ in. long, provide mountings for the jaws. And an eccentric, affixed with a handle and working in a sliding block, supplies the force to operate them.

An equal amount is milled away on the inside of each plate at one end to receive the jaws with some clearance. Mounting is made by way of pivot pins pressed into the plates and through the legs of the jaws. One jaw pivots on the left plate and the other on the right. At the opposite end, the plates are joined by a shoulder screw to form a scissor-action pivot.

Depending upon whether the clipper is to be left or right-hand operated, a rectangular slot is milled completely through one of the plates. The one illustrated is operated with the left hand, the right hand being used to feed the work into the jaws. Size of the slot is 1⅜ in. by 2⅛ in., its center located 3⅝ in. from the front end.

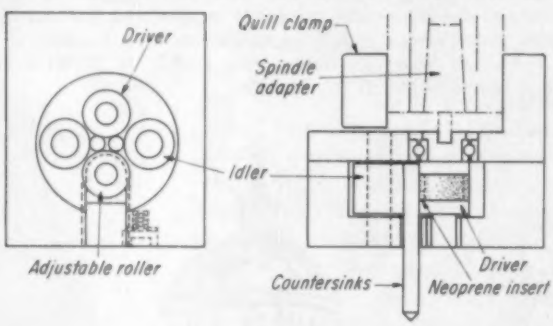
Affixed to the other plate by riveting is a stud which projects through and in the center of the slot. This serves as the axle for the eccentric and should be substantial enough to withstand the compounded force of the eccentric action.

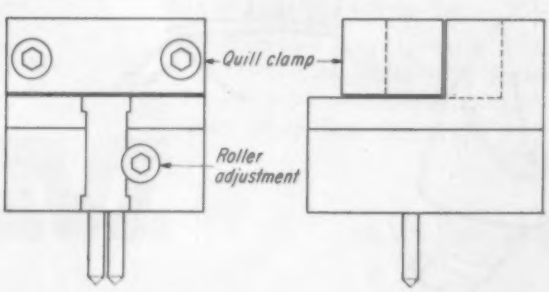


The eccentric is turned 3/16 in. off center, from the center of the axle hole, in a disk 2½ in. OD x 1⅛ in. thick. Its height is ⅝ in. and its diameter 1¼ in. A 1⅜ in. square block, 0.620 in. thick, is next bored to a running fit on the eccentric. Attaching a lever to the eccentric is done by either screwing or riveting a 1 x ½ x 11 in. bar to the outer face of the disk at such an angle that the jaws close when the lever is brought forward. A machine handle fitted to the lever makes for more convenient manipulation. After the clipper has been assembled, it is secured to a support by capscrews through the two holes drilled edgeways in the right hand or stationary plate.

Frederick C Lurz, Garden City, NY

Dual-Countersink Head Doubles Production





Closely situated holes in a large number of press stampings had to be countersunk and, because of their proximity, we first began countersinking them separately. Oh, we tried our adjustable drill head to drive a pair of cutters, but the minimum center-to-center distance was ½ in.; too great for this particular job.

Something else, then, had to be devised if production were to improve. The dual countersink head illustrated is the result of a little planning and some machining.

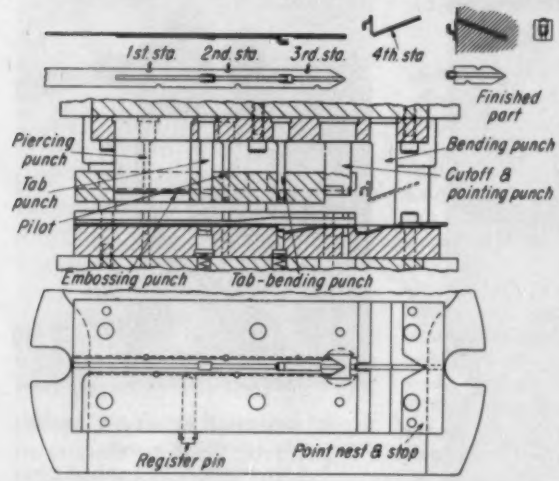
It is made to clamp onto the quill of the drill press and carries, in its housing, rollers which drive two countersinks. One of the rollers is adjustable so that, by changing to different diameter cutters, other center-to-center distances can be reached.

The driver, or power roller, has a neoprene insert to add resiliency and is driven by an adapter mounted in the spindle. A radial thrust bearing on the neck of the driver takes the thrust of both cutters with the least amount of friction. All rollers are hardened, and the cutters may be of drill rod, high-speed cutter blanks, or drills altered to suit.

Two methods are available to present a cutting edge as the cutter rotation is reversed with a right-hand turning spindle. The first is to reverse the spindle, but if this can't be done, make the cutters left-hand cutting.

Ernest J Goulet, East Haven, Conn

Progressive Die Produces Picture Hangers from Strip Stock



This die performs seven operations in four steps in the production of picture hangers from 0.040 in. thick by ½ in. wide steel strip fed from a roll. Each hanger is embossed to increase strength and is provided with staggered notches (one on each side) for a better grip in the wall material after installation.

In the first step, where the stock is fed into the die from the left against a register pin, two operations are accomplished. An embossing punch indents the center of the strip while piercing punches on either side produce the notches. The notches are next picked up by two pilots in the second step where a punch pierces the metal from which the hook is produced.

From here the strip advances to cover the third step where the hook is bent down and forward by a punch against an ejector pin. Simultaneously, the point of the hanger is finished to 60° by a dual-purpose punch which, in the fourth and final station, also severs the required stock length from the strip. This length is determined by a stop plate having a 60° V-notch in which the strip nests.

Following the cutoff in the last station, a forming punch comes down to bend the hanger into its final shape. The finished part is removed from the die with air ejection. From this point on, an automatic roller feed takes over to move the strip to the stop plate.

As a finishing touch, after deburring and case hardening, the parts are plated.

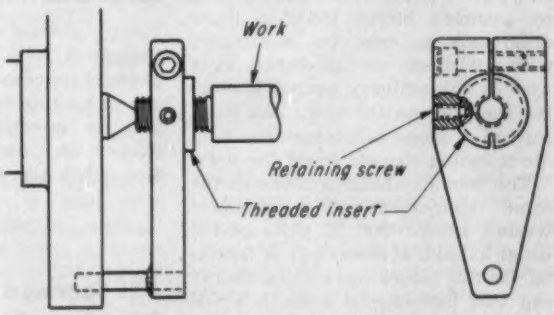
Hjalmar Dahl, Upplands Vasby, Sweden

Driver Takes Threaded Work

One of the difficulties with driving work between centers for secondary operations, is, if the end to be driven is threaded, the threads may be marred by the driver. This applies, of course, only when a conventional driver is used; not when the driver illustrated is on the job.

Not only does this driver work without damaging the threads, it is also faster to use than ordinary drivers which have to be lined with soft material to protect threads. Another advantage is that one driver like this , being equipped with different thread-diameter bushings, can handle a wide variety of work sizes.

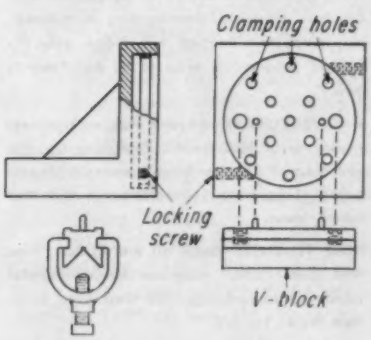
The body of the driver is cut from steel plate, bored to a standard size for the bushings, slit, and fitted with a clamping screw. A driving pin at the other end, either screwed or welded in place, engages a slot in the face plate.



All bushings are tapped or thread bored, then slit through one wall thickness and partially through the opposite side. They are held in the bore with a dog-point screw engaging a hole drilled at 90° to the slits.

M W Loftus, Chicago, Ill

Angle-Plate Insert Revolves



This angle plate, because of its insert, has proved to be a distinct asset in our shop for milling or grinding small parts at multiple angles.

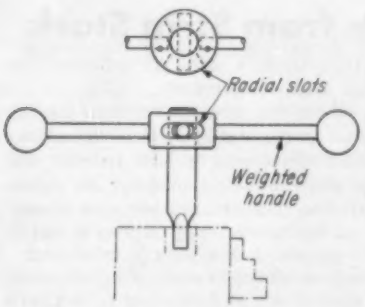
Work may be clamped directly to the insert, or a V-block like the one shown can be used to hold bar stock. Threaded clamping holes are provided throughout the insert to take appropriate screws with straps. The two larger holes, located horizontally in the sketch, are clearance holes for flat-head screws with which the V-block is secured. Just inside these holes are two smaller ones to receive the pilot pins in the V-block.

To make the modification, first select an angle plate of the desired dimensions. Then set up and carefully indicate one face to bore the cavity for the insert. The depth of this cavity should be 0.010 in. less than the thickness of insert so it projects that much from the face of the angle plate.

Next turn the OD of the insert to a running fit in the cavity and include a centered retainer groove on the finished periphery. This groove is engaged by two headless setscrews from either side of the angle plate.

Henry E Piltz, East Orange, NJ

Practical Ideas



Shock Wrench Saves Setup Time

With some lathe operators it has become general practice to tap the chuck handle with a hammer in the final setting of the jaws. Though this can apply to both independent-jaw chucks as well as universal, it is more often used in the latter once the jaw which tightens the work most accurately has been found.

In either case, time is lost in picking up and putting back a hammer and, all too often, injuries are caused by glancing blows. Both of these disadvantages can be eliminated with the shock wrench shown. It is used as any ordinary wrench in closing the jaws on the work and then, instead of using a hammer, the handle is swung sharply to set the jaws.

The wrench shank is made in the same manner as on a standard wrench except that, in place of the usual handle, a dowel pin is inserted. On this pin swings a collar carrying two ball-capped rods in a 60° arch by way of two radial slots diametrically through the collar.

M W Loftus, Chicago, Ill

Eraser Polishes Drill Flutes

Drills and taps, used for machining plastics, will perform better if their flutes are highly polished. The reason for this is simple. With a micro finish on the flutes, the chances for the material to build up is practically eliminated.

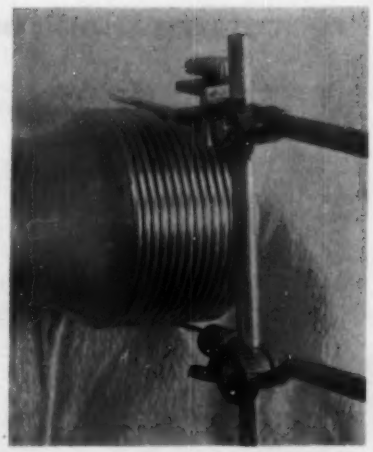
I have found that a fine job of flute polishing can be done with an ordinary typewriter eraser. All you'll need besides the eraser is a simple shank so it can be chucked in a high-speed drill press. A No. 10 machine screw, a pair of washers, and a nut make an effective shank with means of securing the eraser.

These erasers contain a mild abrasive that may be obtained in several grades of abrasive concentrations; just ask for a "fast" or a "slow" eraser. Being soft and flexible, these "polishing wheels" will readily form themselves to a perfect fit in the flute. Photo shows a tap being polished.

H J Gerber, Stillwater, Okla

Wire-Holding Fixture Eases Large-Dia Thread Measuring

The three-wire method of measuring threads is relatively easy when diameters are reasonably small. An assist in holding the wires can then be had by inserting them in sponge rubber, clay, cork or what have you. But, when the diameter of the part to be measured is several inches, these aids are of little use.



When we recently had one of these large-diameter jobs, we found it necessary to make up the fixture shown in the photo. It consists of two clamps, one to hold a pair and the other to hold a single wire. The clamps are brazed to short lengths of steel tubing which in turn are clamped to a beam, also of tubing.

This arrangement makes it possible to apply three wires to a wide range of work diameters even with the work still mounted in the machine.

R W Vogel, Jacksonville, Fla

J H Sperman
Brooklyn, NY
Won $25 for his idea:

Simple Parts Make Efficient Air-Gage Head
in the Sept 19, 1960 issue

AN EXTRA $25 will be paid for the best Practical Idea in each issue of *American Machinist/Metalworking Manufacturing*. Selection of the winning idea is made by a group of our readers.

PAYMENT—in addition to regular rate for item published—will be made as soon as tabulations are completed. The winner or winners—in case of a tie when duplicate prizes will be awarded—will also be announced in these pages.

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WHO MAY ENTER—Anyone may enter except employees of McGraw-Hill Publishing Co. Inc. and those of its advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER—Send all entries to: "Practical Ideas Editor" *American Machinist/Metalworking Manufacturing*, 330 West 42nd Street, New York 36, NY.

Jack Kleinoder

This onetime German tool and diemaker is deeply concerned over American industry's failure to encourage metalworking craftsmanship in an era of growing foreign competition. Today a top executive of a top company and perhaps the tool and die industry's most honored man, he travels widely, devoting himself unstintingly to a renaissance of American skills, pride of craft and product quality . . .

Crusader

"America can no longer afford to make products that are 90% perfect. In this day of growing foreign competition, they've got to be 100% perfect. We can't fight such competition on prices, only quality."

Sometimes an official, sometimes unofficial, but always an eloquent spokesman for America's tool and die industry, German-born Jack Kleinoder preaches the twin gospels of product and worker quality wherever he goes. And Kleinoder gets around: This year alone he has visited Japan once, Europe twice, and shuttled from coast to coast and up into Canada with the regularity and aplomb of a 9-to-5 commuter.

Kleinoder is a man who practices what he preaches. Product quality is a fetish at Volkert Stampings Inc, Queens Village, N Y, a firm he cofounded just 25 years ago with fellow German immigrant tool and diemaker John Volkert.

When Jack Kleinoder arrived in this country, "(Not broke, but not rich either") just ahead of the stock market crash of the 20s, good tool and diemaking jobs were hard to get, especially for a man who couldn't speak English too well. "I must have changed jobs a dozen times the first year. The jobs I liked I couldn't keep and vice versa."

A little later, a man came to visit Kleinoder, bringing a gift from a friend in Germany. "I'm John Volkert," he said. The two, who had much in common—had in fact worked in the same plant in Germany—decided to room together, along with another young bachelor.

In 1934, Kleinoder and Volkert rented the bottom floor of a two-story building in Brooklyn, and went into the stamping business. They switched to the tool and die business when they found the dies they needed cost too much for their already stretched pocketbook.

Today, 25 years later, Volkert and Kleinoder still share a suite of offices—much more plush ones — at their Queens Village plant, go to lunch together, and frequently visit each others' homes.

Together, they have built up such a reputation for quality electronic stampings and components that in these times of near-recession, the company is stepping up production to meet a flood of orders from some of the nation's top companies.

But such product excellence cannot be achieved without worker excellence, and the two go hand in hand at Volkert, which has a program that has been cited by the U S Bureau of Apprenticeship as "the ultimate in apprenticeship training for the tool and die industry."

Beaming proudly as he conducts visitors through the spotless 50,000-sq-ft plant, Kleinoder points to the half-dozen-or-so apprentices at work, "We school and train these men in every phase of the trade, so that they can cope with *anything* that comes up in their lifetime."

"But don't think this is typical. Why, do you know that out of the 2400 tool and die shops in this country, 1300 don't train *anybody*? They either pirate their people, or they're content to go along with a situation that gets worse every day. Right

now, we are losing more skilled men through death, retirement, and promotion than we are replacing—it's a bad thing."

So bad, in fact, that Kleinoder thinks that one day soon we will not only be unable to provide the new tooling required to make increasingly complex products, but that we will be unable even to maintain the equipment and machinery we have already created.

"No pushbuttons, and no automation for that matter, can ever replace the skilled tool and diemaker or machinist. On the contrary, more and more skills will be needed all along the line."

Somewhere, too, along the line, Kleinoder fears that many U S shops have lost pride in their craft, are content to muddle along turning out mediocre products. If pride of craft can be revived, and consequently quality of product, the United States need not fear foreign competition in the domestic or export market.

"I have found in my travels abroad," he says, "that American machines are desired wherever our quality is better, regardless of price."

In Japan, for example, which he visited this spring as a member of a U S trade commission, he found industrialists particularly eager to get top-quality U S machines providing, of course, that they can get credit.

Contrary to public opinion, he claims, the Japanese are just as afraid of a flood of U S imports as we are of a deluge of Japanese goods.

The Japanese, Kleinoder says, are just great on turning out such consumer goods as cameras, watches, transistor radios and the like, but they are weak on heavy industrial and precision equipment—"They're 15 to 20 years behind us industrially, but they're closing the gap fast, producing some pretty good machine tools, and should be up to U S levels within 10 years."

As to Europe, and especially the Common Market countries, Kleinoder feels that a vast economic realignment is in the making. He points out that already hundreds of thousands of Italians, Greeks, and Spaniards are working in West Germany and in Switzerland.

This, he believes, will one day raise the standard of living all over Western Europe, because migrant workers will not only send money back to the less-developed countries, but by emigrating will alleviate job shortages in their native lands.

What will it all lead to? Kleinoder believes that within 25 years, West Europe will be one vast industrial complex with trade and customs barriers down, and "It won't surprise me if interchange of workers between European countries will be as effortless and as common as it is between the U S States today."

Kleinoder has talked over the apprentice training problem with industrialists in many countries, finds the U S dilemma is far from unique. In Germany, for instance—long-famed for its precision metalworking skills—young men are "white-collar happy," are no longer eager to learn the skills of their fathers. One shop owner asked his school district for 123 apprentices, got seven.

Kleinoder, who was a member of the first trade mission to Yugoslavia ("Primitive, a good 25 years behind us industrially") has since visited plants in Japan, and most European countries, including Switzerland, where he picked up Vidmar, an industrial equipment storage system which Volkert now manufactures under license in a new plant at Williamsport, Pa.

But he picks up other ideas, too: New concepts in tool and diemaking and in apprentice training, which he passes on to industrial and civic groups all over the country. In fact, after he retires Kleinoder plans to devote much of his time to the job he has already done so well—encouraging young people to take up the skills that modern industry demands and, conversely, persuading industry to provide the opportunities that youth demands.

Many honors have come to Kleinoder in his 54 years—presidency of the National Tool & Die Manufacturers' Association last year and five-time chairmanship of NTDMA's Apprentice Training Committee, presidency of the New York Tool & Die Institute, Life Membership in the American Ordnance Association, two certificates of service from the Department of Commerce, a Certificate of Meritorious Service from the Department of Labor "for outstanding service . . . in developing and maintaining the highest standards of trade craftsmanship," and this year the NTDMA L A Sommer Memorial "Man of the Year" Award.

But Kleinoder is proudest of all of an honor he shares with his long-time friend and business associate, John Volkert. This year, on the occasion of the company's 25th anniversary, their 175 employees presented them with bronze busts of themselves—a rare, unsolicited tribute from the people in whom he has instilled his concepts of quality and craftsmanship.

Sheffield Corp, Dayton, Ohio, subsidiary of **Bendix Corp,** has announced that **Jack T Welch** (left), Sheffield vice president of sales, has transferred to Bendix International, New York, where he will become director of industrial marketing. **William I Wilt** (center), vice president, advertising and promotion, has been named vice president, marketing, and will direct Sheffield's domestic and export sales. **Walter Burkart** has been promoted from assistant manager to manager of the Machine Tool Division

Buhr Machine Tool Co, Ann Arbor, Mich, has appointed **Richard Miller** manufacturing manager. Mr Miller has held executive and manufacturing positions in the machine tool and automotive industries

Waterbury Farrel Foundry & Machine Co, Waterbury, Conn, division of **Textron Inc,** has named **John E Eckert** vice president, engineering. He was previously chief engineer of the Rolling Mill Division

John M Rudel has been elected president of the **Canadian Machine Tool Dealers Association.** Mr. Rudel is president of **Rudel Machinery Co Ltd** which has recently merged with **Canadian Fairbanks-Morse Co Ltd.** At the time of the merger he was named a vice president and director of Canadian Fairbanks-Morse

Logansport Machine Co, Logansport, Ind, has elected **L R Burger** vice president of sales.

Barden Corp, Danbury, Conn, has elected **Perry R Roehm** executive vice president. Mr Roehm rejoined Barden as vice president last July after having been with the firm from 1944 to 1955 as sales manager and vice president.

Chrysler Corp has appointed **Paul M Nash** manager of the Mound Road Engine Plant. Mr Nash has been serving as quality control manager for the Power Train Group and before that was chief engineer for the Axle and Transmission Division.

Clearing Division of US Industries has named **W H Stout** vice president and comptroller. **Boyd Helm** has been appointed general manager of the Die Division. Mr Helm has been associated with the die field in Detroit for many years and has been a member of the Clearing Die Division staff for the past two years. **LeRoy W Prochnow** has been made manager and **Louis Murray** assistant manager of the Subcontract Division of Clearing.

Arrow Tool Co, Wethersfield, Conn, has appointed **Frederick F Ward** vice president. He moves up from the post of sales manager.

Diehl Manufacturing Co, Somerville, NJ, subsidiary of **Singer Manufacturing Co,** has elected **Leonard C Marsac** president to succeed **W O Langille,** now board chairman. Mr Marsac has been executive vice president.

(Continued on p 232)

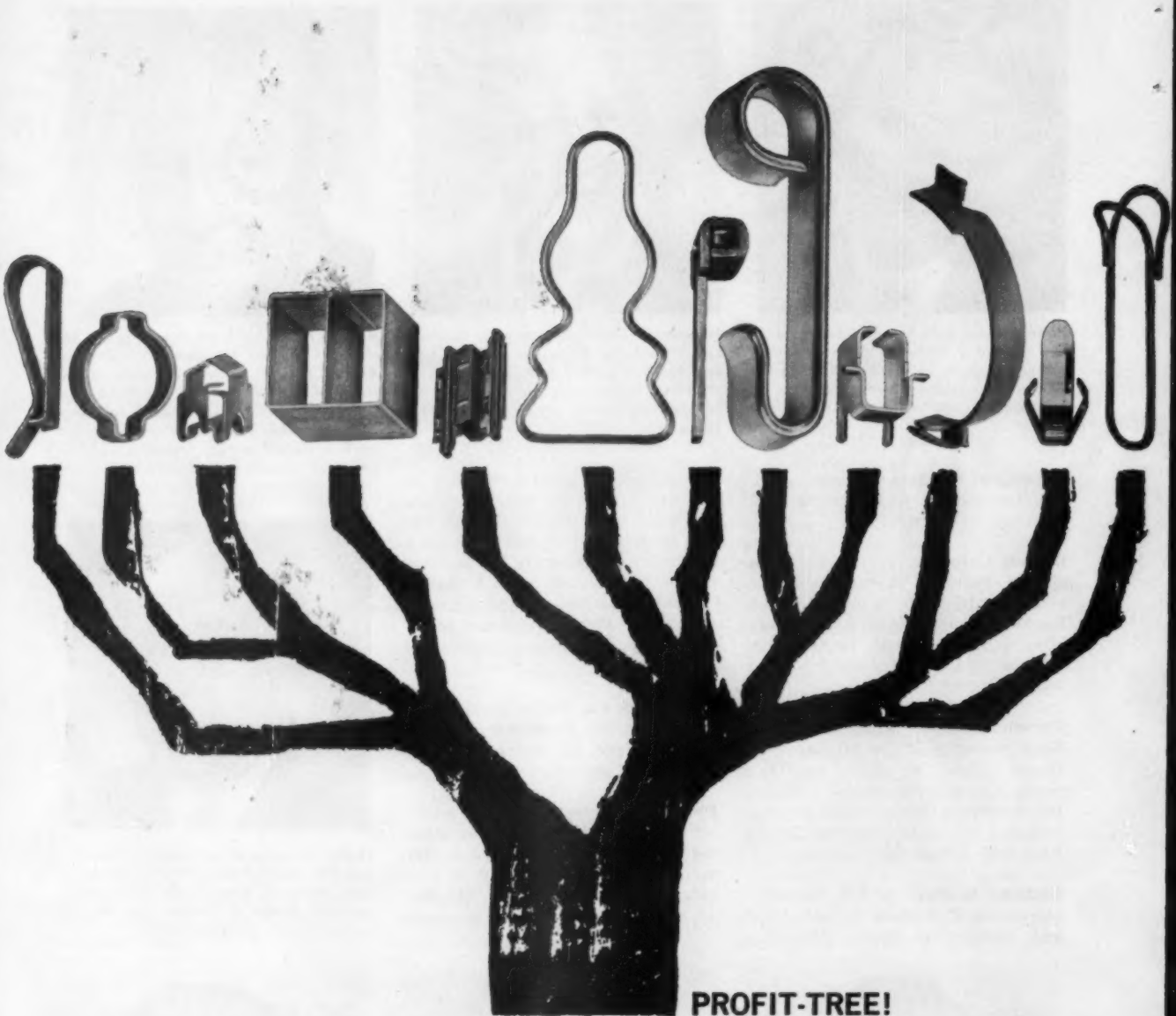
Dodge Manufacturing Corp, Mishawaka, Ind, has named **Fred J Ebeling** director of sales. Formerly general sales manager, he succeeds **Harry A Torson** who has resigned as vice president, sales

Ford Motor Co has appointed **K N Krecke** manufacturing manager of the stamping plants. **Christopher E Bowles** has been named manager of the Dearborn engine plant, succeeding Mr Krecke, and **Walter H Johnson** is now production manager

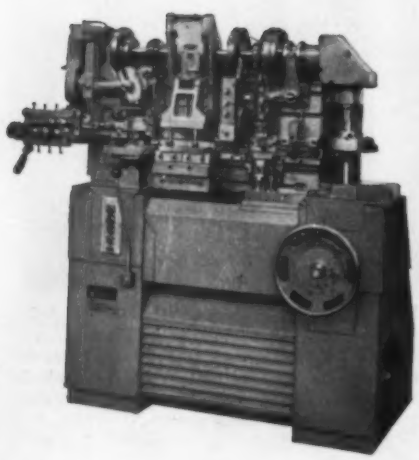
Milford Rivet & Machine Co, Milford, Conn, has named **D Wheeler Clark** general sales manager. Since joining the company early last year as assistant to the president, Mr Clark has been specializing in development of inventory and production controls

Mallory Metallurgical Co, Indianapolis division of **P R Mallory & Co,** has named **Paul L Hotte** president. He was formerly general manager of the company which manufactures resistance welding products and powder metal parts

THESE PARTS ARE BEING PRODUCED AT SPEEDS OF 90 TO 250 PCS/MIN



PROFIT-TREE!



These are formed parts produced in single automatic operations on the revolutionary new Torrington Vertical 4-Slide.

With precision and speed, the Verti-Slide has replaced as many as five and six progressively tooled presses in the production of a complex part. Normal secondary operations such as welding are being done in one continuous automatic operation in excess of 100 pcs/min.

If you make or buy complex wire or strip parts, the Verti-Slide method offers dramatic reductions in production cost. Less parts handling, in process inventory, machine space—all mean greater profits to you.

Write or call for field technical data or a Torrington Sales Engineer.

THE TORRINGTON MANUFACTURING COMPANY

MACHINE DIVISION Torrington, Connecticut

CIRCLE 377 READER SERVICE CARD

Alcoa Aluminum Screw Machine Alloy Is Said To Be First New Stock In 25 Years

Alloy 6262-T9, said to be the first screw machine stock developed in over 25 years, is expected ultimately to replace alloy 6061-T6 as a standard material for making fasteners and specialty screw machine parts.

Alcoa claims that the stock machines better than any of the four standard screw stock alloys except 2011-T3. For comparison, if free machining alloy 2011-T3 is given a relative chip size rating of 1.0, alloy 6262-T9 has a 1.4 rating. On the same scale, alloys 2017 and 2024 have chip size ratings of between 2.0 and 3.0, and alloy 6061-T6 has a 4.0 classification. The guaranteed minimum yield strength of the new alloy is higher than typical yield strengths of any of the four standard alloys. Its corrosion resistance and finishing characteristics are as good as those of alloy 6061, and better than the other three.

This new alloy, which is a member of the aluminum-magnesium-silicon family and contains lead and bismuth for increased machinability, is expected to be used for fittings and couplings, where strength and corrosion resistance are important, and for components in cameras and other products, where finishing characteristics and machinability are prime considerations.

Minimum mechanical properties of alloy 6262-T9 are 52,000 psi tensile strength, 48,000 psi yield strength, and 5% elongation. Typical properties are 58,000 psi tensile strength, 55,000 psi yield strength, and 10% elongation.

Priced the same as alloy 6061-T6 it is available in standard 12-ft lengths, round or hex rod and bar.

Alcoa, 761 Alcoa Bldg, Pittsburgh 19, Pa

MORE DATA? Circle 88, inside back cover

Anaconda Introduces Alloy For Use in Place of Copper

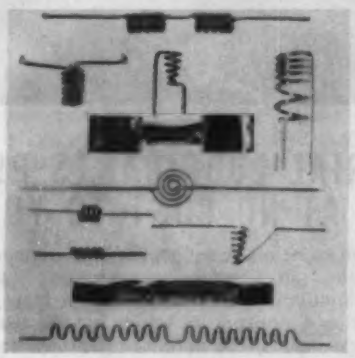
Leaded nickel copper-831, a new precipitation-hardening alloy composed of copper, lead, nickel, and phosphorus, has high corrosion resistance, high tensile and yield strengths, high electrical conductivity, and free machining quality. Nominal composition is: copper, 97.80%; lead, 1.00%; nickel, 1.00%; and phosphorus, 0.20%.

While the full potential for this new-type bronze is still being developed, its combination of properties would suggest such end uses as electrical contacts, connectors, control elements for power tubes, and structural elements now copper.

At present, the material is produced in round rod in sizes from 3/32 to 1¼-in. diameters, and standard dimensional tolerances for nonrefractory alloys will be met. It has 85,000 psi tensile strength, 75,000 psi yield strength, 5% elongation, 55% electrical conductivity, and machinability rating of 80% that of free cutting brass.

The Anaconda Co, 25 Broadway New York 4, NY

MORE DATA? Circle 89, inside back cover



Line of Filaments and Boats Made for Use in High Vacuum

This new, complete line of tungsten, tantalum, and molybdenum filaments and boats are now available for use in high vacuum as an evaporation source. They are processed to maintain a high standard of purity and accuracy.

All parts are stress relieved to obtain the longest possible life in operation and to maintain their geometry during use. Primary uses for these filaments and boats include: electronic component processing, coating of optics, plastics and toy decorative coating, precision instrumentation manufacturing, and vacuum metalizing in basic research laboratories.

Electronics Div, Allen-Jones, Inc, 1345 Gaylord Ave, Long Beach, Calif

MORE DATA? Circle 90, inside back cover

Nickel Stripper Introduced

Enstrip S-60, a ready-to-use stripper for nickel and other metals, is a free-flowing, readily soluble powder which need only be added to water at room temperature to make a solution which will strip nickel from steel. The material contains all of the ingredients, including sodium cyanide, which are required for effective stripping.

Enthone, Inc, 442 Elm St, New Haven 8, Conn

MORE DATA? Circle 91, inside back cover

Forming Lubricant, Effective To 2200 F, Prevents Galling

Phosphatherm RN, a metal forming lubricant for use at temperatures between 1100 and 2200 F, is said to prevent galling, scoring, and metal pickup when forming most types of steels, steel-copper alloys, and exotic metals. It is an eutectoid, or gradually softening mixture containing phosphates.

Alpha-Molykote Corp, 65 Harvard Ave, Stamford, Conn

MORE DATA? Circle 150, inside back cover

Aluminum Electrode Has Patented Extruded Flux Coating

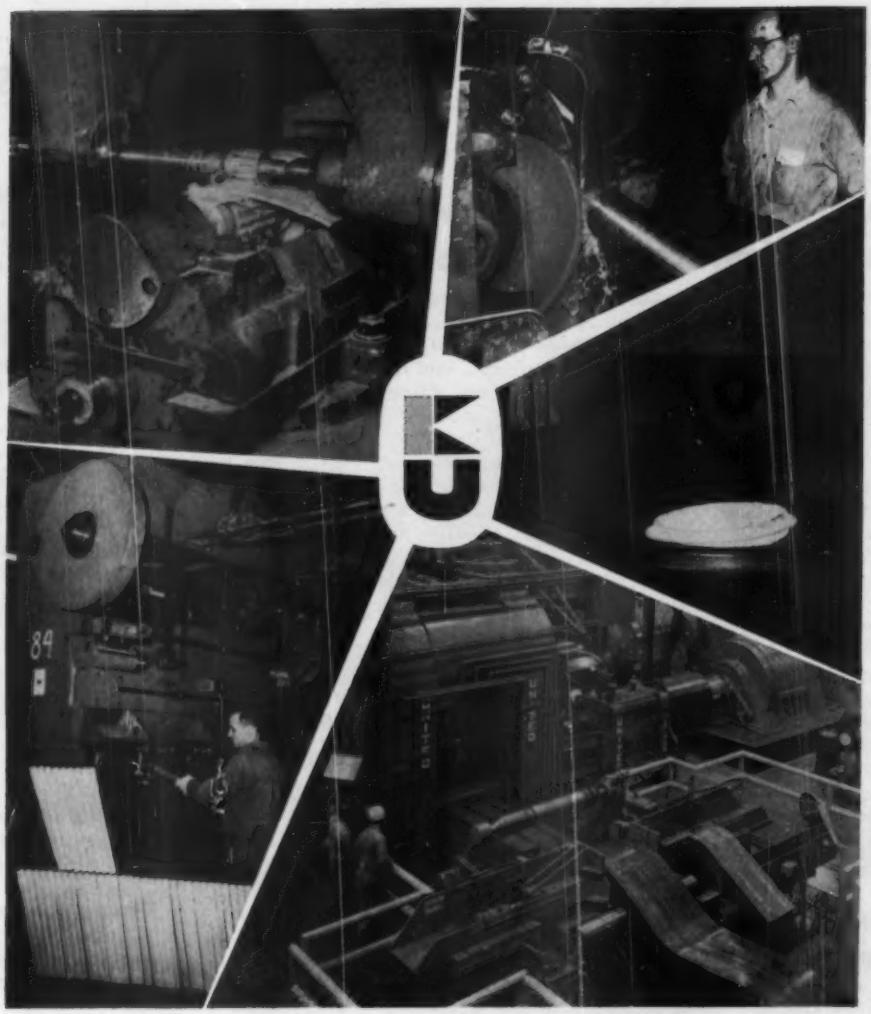
All-position Smoothcote No. 34 aluminum electrode, which has a patented extruded flux coating, develops tensile strengths up to 28,000 psi. The aluminum alloy 4043 core wire is combined with a velvet-smooth coating which reportedly gives quiet welding and dense, spatter-free deposits at low amperages.

Slag removal and deposition control are said to be far superior to standard dip-coated electrodes.

No. 34 Smoothcote electrode is recommended for aluminum railings, tanks, pipe, truck and automobile construction and repairs, for build-up of missing sections, cladding, and reinforcing.

All-State Welding Alloys Co, Inc, 249-55 Ferris Ave, White Plains, NY

MORE DATA? Circle 92, inside back cover



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Caterpillar Tractor
Chase Brass & Copper
Chevrolet
Chrysler Corp.
John Deere Co.
Douglas Aircraft
Dow Chemical
Ford
General Electric
Harnischfeger
Harvey Aluminum Inc.
Hotpoint
IHC
Kaiser Industries
Keystone Steel & Wire
Lockheed Aircraft
Maytag
Minneapolis Honeywell
North American Aviation
Northwestern Steel & Wire
Olin Mathieson Chemical
Pittsburgh Plate Glass
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Remington Rand
Republic Steel
Revere Copper & Brass
Reynolds Metals
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Hot Work Die Steel Comes In Many Sizes

H-W-A—a 5% chromium, 1% molybdenum, 1% vanadium die-casting die and general hot-work steel—is now available in sizes which range from ½ to 10 in. in rounds; from ¾ x 1 to 6 x 25 and 8 x 20 in. in flats; from 1 to 5 in. in squares; and from 3 to 14 in. in square billets.

This steel responds to heat treatment over a wide range, air or oil quenching from 1800 to 1950 F to Rh 5 0to 55 C. It retains this high hardness when drawn—even up to 1000 F—but can be tempered back to working hardness of 440 to 490 Bhn at 1050 F.

Darwin & Milner, Inc, 2222 Lakeside Ave, Cleveland 14, Ohio

MORE DATA? Circle 93, inside back cover

Chemical Cleaning Composition Removes "Hard-to-Get" Soils

Kelite No. 25E (Patent pending), is a dustless powdered composition capable of removing difficult oily soils, fatty soils, and greases from hard surfaces. It is a non-caustic alkaline cleaner that exhibits cleaning efficiency attained previously only with heavy-duty highly alkaline compositions.

The product, which is safe and non-toxic to personnel under normal conditions, does not attack sensitive substances such as organic finishes, aluminum alloys, brass, and other copperous alloys because it uses a new synergized surface active system.

No. 25E, which dissovles readily at ambient temperature, exhibits high soil removal efficiency at moderate pH.

Kelite Corp, 81 Industrial Rd, Berkely Heights, NJ

MORE DATA? Circle 94, inside back cover

Flux-Coated, Silver Brazing Alloy Said to be First of Type

This flux-coated, silver-brazing-type alloy, which will cut brazing time by two-thirds through elimination of separate flux, is available in rods of 1/16 and 3/32-in. diameters. The EutecSil 1020FC alloy offers for the first time the advantages of conventional silver-brazing-type rod while it eliminates the need for flux mixing and application and reduces the need for pre-cleaning and pre-heating.

Features include low application temperature, high fluidity, strength, and high electrical conductivity. Deposits are cadmium-free and thus the product may be used safely on food vessels and processing equipment.

Eutectic Welding Alloys Corp, Flushing, NY

MORE DATA? Circle 95, inside back cover

Aluminum Spray-Paint Resists Temperatures Up to 1000 F

Sprayon No. 324 high-heat aluminum paint, which can withstand a temperature of 1000 F for intermittent periods, is packed in a 16-oz aerosol can. Specially formulated for high-temperature applications, No. 324 paint withstands a temperature of 500 F indefinitely. Covering fast and economically, it is intended for steam pipes, furnaces, ovens, motors, and engines.

Industrial Supply Div, Sprayon Products, Inc, 2075 E 65 St, Cleveland 3, Ohio

MORE DATA? Circle 96, inside back cover

Cutting Fluid, Coolant Made For Heavy Duty Operations

Trim HD, a new cutting fluid and coolant which has been specially formulated for the severest machining and grinding heavy duty operations, is said to eliminate many difficulties peculiar to heavy broaching, reaming, threading, and tapping. The very low viscosity of Trim HD allows the fine chips to settle rapidly, whereas heavy oils hold the chips, wedging them between relief of the tap and work, causing rapid wear, and often breaking the tap.

The fluid, which is a white jell that is diluted with water, does some of the toughest jobs on alloys, stainless, and cast iron; yet, it doesn't stain brass or aluminum. The translucent fluid causes no odor, rancidity, gumming, or skin irritation.

Master Chemical Corp, Toledo, Ohio

MORE DATA? Circle 97, inside back cover

Steel Hardening Compound Provides Rockwell Hardness of 60 to 65 C

Hard-N-Tuff is a non-toxic compound that carburizes, nitrides, and chromites in one operation. A single application on mild steel tools, dies, and wearing parts provides a surface hardness of 60 to 65 Rh C, 0.003 to 0.006 in. deep. Deeper case may be obtained by repeating.

Parts are merely heated to red heat, plunged in the hardening compound, re-heated, then quenched.

Hard-N-Tuff Corp, Box 275, Huntington, NY

MORE DATA? Circle 98, inside back cover

M&T Adds Low Alloy Electrode

A new heavy-coated, shielded-arc type of low alloy steel electrode, designated Speedex 710 Mo, meets AWS and ASTM requirements as a class E7010-A1 electrode. It is recommended for any low alloy, high tensile steel applications. The electrode, which can be used in all positions with direct current, reverse polarity, has deposits which contain approximately ½% of molybdenum.

Metal & Thermit Corp, Rahway, NJ

MORE DATA? Circle 99, inside back cover

Richardson Has New Grade of Flame-Retardant Laminant

Insurok, T-777 is a paper-base, phenolic laminate with exceptional flame-retardant characteristics. Also, it is immediately available copper-clad or non-clad. The T-777, which meets NEMA XXXP requirements, is rated as self-extinguishing with zero inches burning distance.

Along with this flame retardance which is believed to be permanent at normal operating temperatures, T-777 possesses good electrical properties, fine dimensional stability, and superior punching qualities.

The Richardson Co, 2735 Lake St, Melrose Park, Ill

MORE DATA? Circle 100, inside back cover

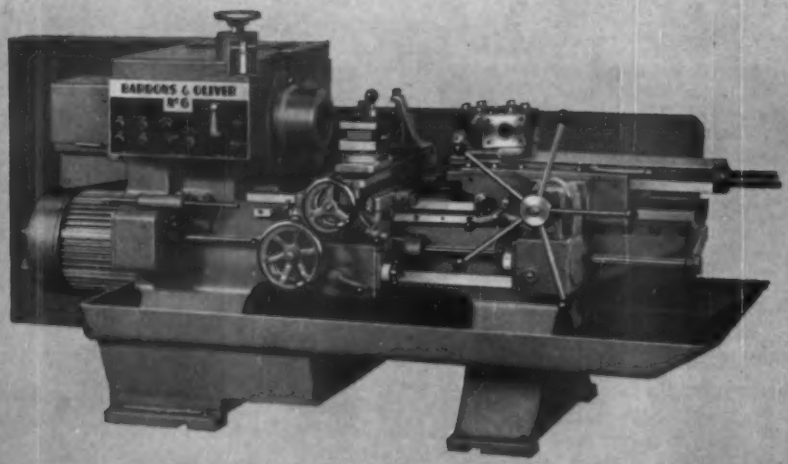
Coolant Has Visual Efficiency Index

Rycosol 66, an effective coolant for cutting and grinding machines, contains a special color ingredient that offers visual proof of the solution's efficiency. It gradually loses its color as it becomes less efficient through continued use.

The solution can become completely colorless before the operator is in trouble. Then, to reactivate it, he merely adds a small amount of fresh Rycosol 66. Thus, through its own efficiency index, it protects both work and tools, eliminates all need for laboratory tests, stretches the interval between sump changes, and assures top efficiency at lower costs.

Reilly-Whiteman-Walton Co, Conshohocken, Pa

MORE DATA? Circle 101, inside back cover



RAM TYPE TURRET LATHES		
Size	Bar Capacity	Swing Over Bed
No. 2 Geared Electric	1" or 1¼"	13½"
No. 3 Universal	1½" or 2"	15½"
No. 4 Universal	2" or 2½"	18¼"
No. 6 Universal	3" or 5"	21¼"
SADDLE TYPE TURRET LATHE		
No. 21 Universal	3" or 4½"	21¼"

BARDONS & OLIVER

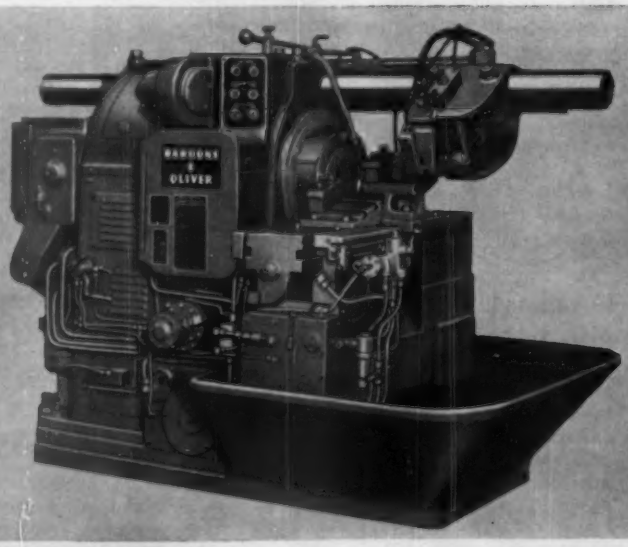
Turret Lathes . . . .

Each of the five Turret Lathes listed is a completely different machine, designed specifically for one range of work. All units on each machine, including the cross slide and carriage, and the turret slide and saddle, are "sized" for a particular work range. Thus adequate strength and rigidity is provided, maximum productive capacity is offered, and at the same time minimum operator effort is required. A complete line of tooling and attachments is available for each size of machine.

Cutting-Off Lathes

The Cutting-Off Lathes are designed to chamfer, form and cut off pipe, tubing, or bar stock with maximum efficiency. The number of pieces produced per hour often equals or exceeds that of much more expensive and complicated multiple spindle machines. Automatic loading tables, chamfer attachments, forming attachments, and automatic unloading devices are available for all sizes of Cutting-Off Lathes. These lathes are built as fully automatic, semi-automatic or hand operated.

CUTTING-OFF LATHES	
Size	Capacity
No. 32	2"
No. 33 and 34	3" and 4"
No. 35 and 36	5½" and 6⅝"
No. 38 and 39	8⅝" and 9⅝"
No. 312 and 314	12¾" and 14½"
No. 316	16"

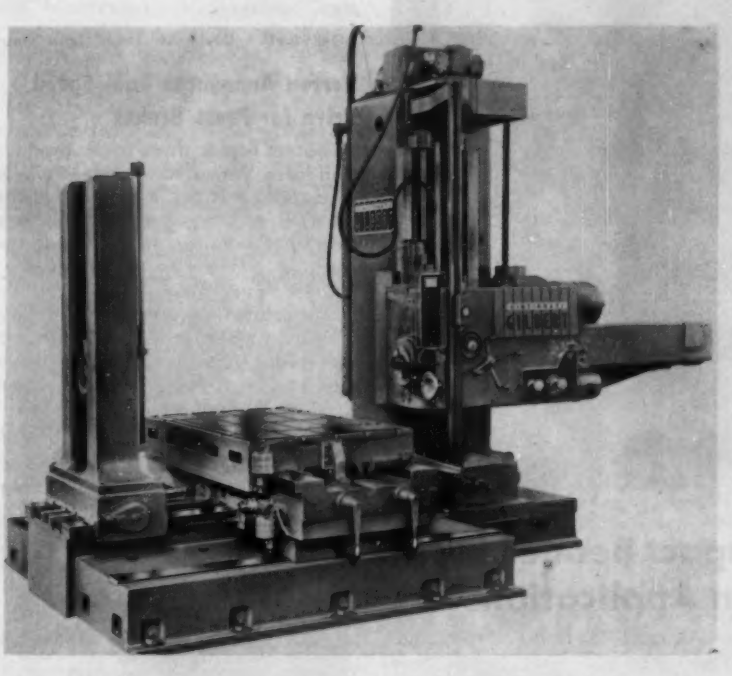


BARDONS & OLIVER

BARDONS & OLIVER, INC., 1133 WEST 9th ST., CLEVELAND 13, OHIO

Manufacturers of Turret Lathes and Cutting-Off Lathes

CIRCLE 379 READER SERVICE CARD



Cincinnati Gilbert Boring Mill Has Building Block Design; N/C Optional

This new 4-inch spindle table type precision horizontal boring mill is designed on the building block principal; therefore, it can be delivered in many combinations of table, saddle, bed, and column sizes. Also, it can be fitted with either numerical or tracer controls.

When it is desired, the machine can be equipped with a General Electric Mark 2, 3, or 4 numerical control system.

In addition to tape controls, the machine may be supplied with a basic vernier measuring system, optical measuring, precision rod and dial indicator measuring, or precision automatic positioning of head, table, and saddle. The automatic positioning device, accurate to 0.0001 in., may be used with precision rods or prebored job rods.

The basic model of this machine has a combination selective pendant and hand shift control; the Di-Matric model has complete pendant control. Feeds and speeds are automatically shifted hydraulically by rotary selector valves mounted on the head. The operator changes feed or speed by turning the control handle to desired feed or speed.

There are 27 spindle speeds, 12 spindle feeds, and 24 feeds to saddle, head, and table on standard machine. As an option, an additional 12 extremely fine feeds to spindle may be selected; these give better finishes on stainless and the exotic metals.

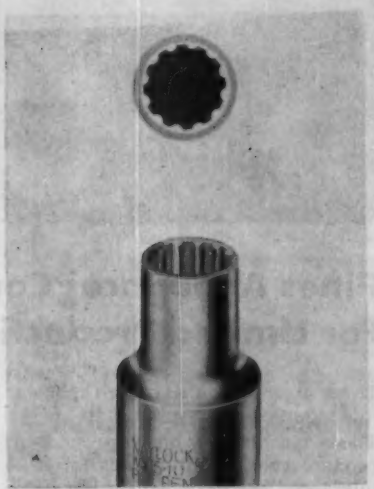
All drive gears, which have either shaved or ground teeth, are made from forgings and hardened; sliding gears are mounted on hardened shafts with splines hobbed from the solid.

Columns are offered with 36, 48, 60, and 72-in. vertical travel of spindle head. Table widths are 38, 48, and 60 in. Lengths go up to 132 in. Beds are offered in a basic 36-in. width, and also in widths of 60, 84, and 120 in. Saddle supports, installed with floor level, are offered with the basic 36-in. wide bed. Bed lengths are 54, 78, 92, 116, and 140 in. from faceplate to bar support.

Optional equipment includes: power clamps for saddle and table, power draw bar for spindle, automatic lubrication of ways, anti-friction bar support bushings, and coolant systems. All of the company's standard attachments may be used with this new machine.

Cincinnati Gilbert Machine Tool Co, 3366 Beekman St, Cincinnati 23, Ohio

MORE DATA? Circle 51, inside back cover



Socket Especially Designed For High Torque Applications

Because of its basic design, this new Kaylock WS15 super torque socket will outlast any conventional type, according to the company which designed it for high torque applications.

Tests by major airframe and engine manufacturers under the most severe conditions were unable to produce a wrenching failure; and in laboratory tests, the socket was undamaged after being subjected 100 times to more than double the torque load specified for standard tests.

Lobes of the new socket grip the wrenching flats, instead of the points, and therefore eliminate any tendency to slip or to round the points of either the nut or the socket.

The WS15, which is made of heat-treated alloy steel and comes in nickel or chrome-plated finishes, is available in ¼, 5/16, ⅜, 7/16, ½, and 9/16 sizes.

Kaylock Div, Kaynar Mfg Co, Inc, Box 2001 Terminal Annex, Los Angeles 54, Calif

MORE DATA? Circle 52, inside back cover

Pines Announces Compact Bender Line For Limited Production Applications

Three machines in the new Compact line handle from ½ to 4-in. IPS pipe. These machines, which are said to produce good quality bends to close tolerances, are designed for low production jobs, one-of-a-kind or experimental parts, maintenance, and similar fabrication work.

The two larger members of the line, the Models C-2 and C-4, feature direct hydraulic operation of the pressure dies. Pressure is easily adjusted by a manual control valve, and exact gage pressure can easily be read and recorded for subsequent duplication of setup.

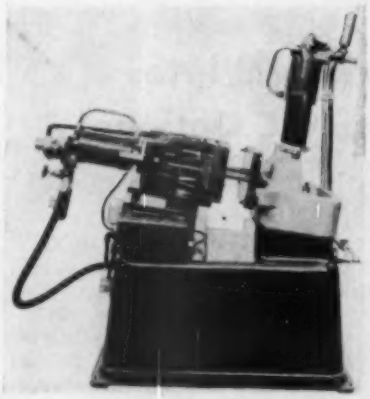
Model C-4, the largest machine in the line, has capacity up to 4-in. IPS standard pipe or equivalent, such as 5 x 5 x ⅜-in. steel angle or 2⅞-in. dia solid steel bar.

The original Compact bender, Model 1400, has a capacity up to ½-in. IPS pipe or 1⅛-in. dia steel tubing. Its invertable top assembly with double tool-holder ways permits two-minute changeover from clockwise to counter-clockwise bending.

Any model of the Compact line can be equipped with hydraulically operated mandrel extractor for use on critical small radius work.

Pines Engineering Co, Inc, 601 Walnut St, Aurora, Ill

MORE DATA? Circle 53, inside back cover



Die Casting Machine Features Modular Automatic Cycling

The MAC/99 die casting machine (British) now has various plug-in attachments which are said to provide a degree of automation and flexibility previously unavailable in a machine of this size. It produces hardware-finish castings up to one pound in weight at about 1000 shots an hour.

One of its most important modules is the automatic ladling preheat furnace. This unit provides a continuous flow of correct temperature metal to the machine pot automatically. When the metal in the machine pot drops to expose one of the two stainless steel probes, the ladle gently rises to fill the pot until the second probe is covered.

DCMT Sales Corp, Div of British Industries Corp, Port Washington, NY

MORE DATA? Circle 54, inside back cover

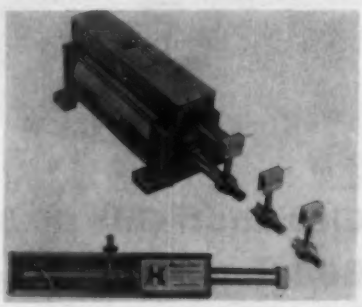
Verson Announces Dual Speed Drive for Press Brakes

To obtain higher press brake production rates, Verson has designed a new dual speed drive. The drive advances the ram at a rapid speed and then slows it down prior to contacting the work.

This drive, which is available on all the company's larger press brakes, permits higher production without the inconvenience and danger produced by high forming speeds when bending large sheets.

Verson Allsteel Press Co., 9300 S Kenwood Ave., Chicago 19, Ill.

MORE DATA? Circle 55, inside back cover



Electrical Mechanical Servo Positions Machine Tool Tables

The Hanna-Powr Positioner, a new electrical-mechanical servo device, automatically positions machine tools, valves, doors, hopper gates, and float levels at any of several predetermined positions which correspond to a control selector switch signal. The positioner is used in conjunction with various types of power mechanisms such as air or hydraulic cylinders, along with solenoid valves applied to operate a pipeline flow valve.

Model PR2A positioner has two cam rods, and a connecting link on one end is attached to the mechanism the positioner is controlling. The other two ends of the steel cam rods trip limit switches as the cam rods slide back and forth inside two channel grooves in the extruded aluminum positioner housing.

There may be as many as 14 sets of limit switches per foot; thus 14 different positioning stops per foot can be made. The positioner may be

made in various lengths up to eight feet long.

The positioner, which is not designed for extreme instrumental accuracies, gives accuracy of ±0.005 in. depending on the mass and weight of load or type of application.

Hanna Engineering Works, Dept PR-26, 1765 Elston Ave, Chicago 22, Ill

MORE DATA? Circle 56, inside back cover

Vibration Exciter Gives Rapid Checkout of Production Lines

Roticon, a complex wave vibration exciter which gives rapid checkout of production line items, has been accepted for the testing program for Titan B. Workmanship defects and substandard components are quickly detected with this device.

Because it has a single switch control and automatic shutoff, the instrument can be operated reliably by production line personnel. Also, nuisance noise is negligible, and it may be operated in production areas. Rotocon sells for $3,850.

Rototest Laboratories, Inc, 2803 Los Flores Blvd, Lynwood, Calif

MORE DATA? Circle 57, inside back cover

Vari-Torque Conveyor Stops, Accumulates, Transports Loads

Chain-driven, live roller Vari-Torque roller conveyor handles a wide range of items from light to heavy. Designed with a forward thrust proportional to weight of the load, it transports loads that can be stopped at any point without stopping the conveyor even on a powered curve, and permits loads to accumulate and assemble for long periods of time without wear on the rollers.

Shafts, sprockets, and driving chain continue to run even when a stop is put on the load. As soon as the load is released it moves forward immediately on high speed rollers that permit the leading load to move ahead of those following.

Harry J Ferguson Co, West Ave, Jenkintown, Pa

MORE DATA? Circle 58, inside back cover

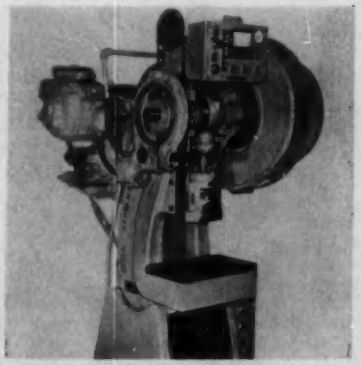
Norden Shaft-Position Encoder Gives 360 Counts per Rotation

Designated the ADC-ST3-36BCD, this shaft-position encoder, which provides 360 discrete counts per rotation of the input shaft, gives its numerical indication of shaft position in degrees—written in 8-4-2-1 binary-coded-decimal form.

It incorporates self-selecting V-brush logic and does not require extensive external brush selection logic circuitry to accomplish its function.

Norden Div, United Aircraft Corp, Wiley St, Milford, Conn

MORE DATA? Circle 59, inside back cover



Industrial Press Cuts, Forms, Runs up to 1,000 Strokes a Min

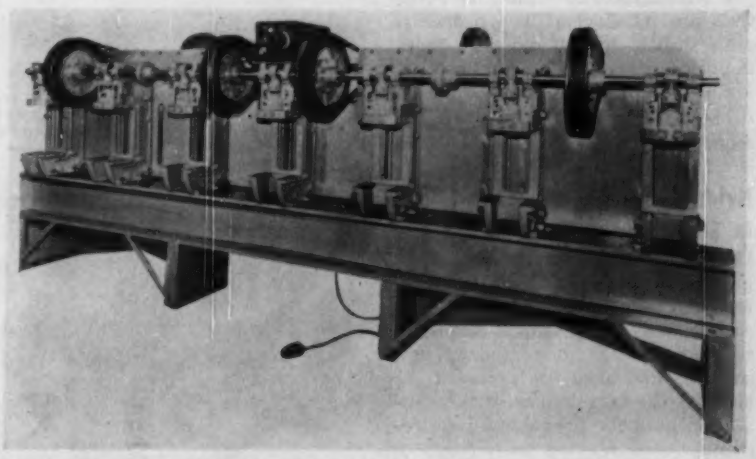
This high-speed industrial press, which can both cut and form metal into electronic components as well as electrical, automotive, and aircraft parts, can run at speeds up to 1,000 strokes per min. Because the strokes can be adjusted to both cut and form, the press performs functions that ordinarily require the use of two or more standard units.

Worn bearings and un-uniform strokes are eliminated on this Zeh & Hannemann press. This is done by mounting the flywheel on a centrifugal force stress absorber instead of directly on the shaft that delivers the strokes.

The model is available in sizes ranging from one to 135 tons.

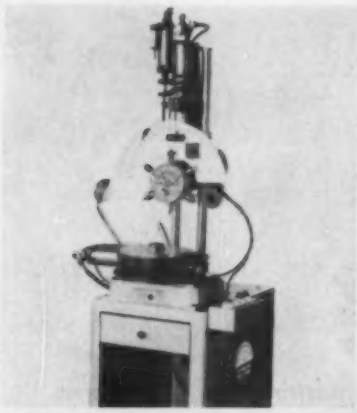
Decherts, 713 W Main St, Palmyra, Pa

MORE DATA? Circle 60, inside back cover



PRESS TYPE PROJECTION WELDER has a 4-station, dial-type upper holder controlled at a 4-button station. When a button is pushed, the head automatically moves the proper die to weld station. Correct air pressure is also selected automatically. Machine has an anti-friction roller bearing slide operated by 12-in. dia air cylinder which develops max weld force of 9000 lb at 80 psi—*Federal Machine & Welder Co, Warren, Ohio*

MORE DATA? Circle 61, inside back cover



Automatic Bench Model Turret Drill Has ¼-in. Steel Capacity

This bench model 6-spindle turret drill has automatic power feed and turret indexing. Therefore, the machine sets the pace and production is increased.

Controlled power feeding is infinitely variable, and spindle speeds automatically shift. Also, the drill has individual depth stops on each spindle to permit rapid traverse to the work and limit depth of cut.

Three models of operation give full flexibility:

- Manual—single spindle operation with power feed, turret indexing only at push button signal.
- Semi-automatic — turret cycles through pre-determined sequence of operations including skip index of idle stations, stopping for manual load and unload.
- Full-automatic — machine's controls are interlocked to synchronize with shuttle tables, index features, hopper feeds, air blasts, and coolant.

Burgmaster Corp, 15001 S Figueroa St, Gardena, Calif

MORE DATA? Circle 62, inside back cover

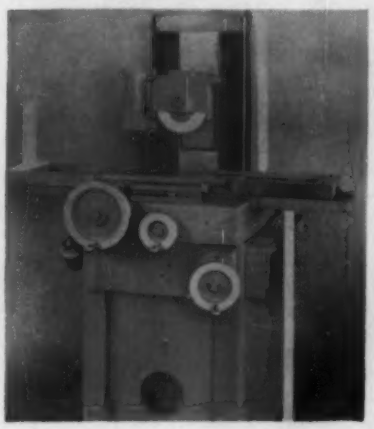
Nylon Fasteners Available In Small Quantity Lots

Users of molded nylon fasteners can get prompt delivery of small lots (as few as 10 of a size) of machine screws, nuts, washers, and screw insulators through a specialized new service. Packaged in units of 10, and 100, the fasteners are also available in bulk for production requirements.

Machine screws with binding, round, fillister, flat, oval, washer, and set screw heads are furnished in more than 60 lengths in thread sizes from No. 0-80 through ¼-20. Hex nuts come in 10 thread sizes from No. 2-56 through 5/16-18. Five washer sizes range from No. 4 through ¼ in., and six screw insulator types from No. 4 x 3/16 through ¼ in. x ⅜. Special assortment package containing 100 of the most useful sizes of all the items is available for $3.

Machine Parts Supply Co, 13 E 37th St, New York 16, NY

MORE DATA? Circle 63, inside back cover



Hand-Operated Rollerway Grinder Is Equipped With 78 Rolls

Model 618-HR has a total of 78 precision rolls that support the table and work. They are so spaced that successive rollers do not complete each revolution at the same spot along the ways as a previous roll. Rolls are separated by non-metallic retainers which eliminate metal to metal rubbing and subsequent scoring and scratching. A special grade of cast iron with a steel additive is used in the cross slide and table to provide extra hardness for the way surfaces.

This model is also equipped with a table locking device that assures absolute stability when dressing the wheel. A variable tensioning device has been engineered into the unit to compensate for those operators doing a special grinding job for which the table might move too freely. This, plus the proper gear ratio for turning the handwheel, eliminates the so-called snap when reversing the table to overcome the inertia of the table motion when the table is heavily overloaded.

Reid Brothers Co, Beverly, Mass

MORE DATA? Circle 64, inside back cover

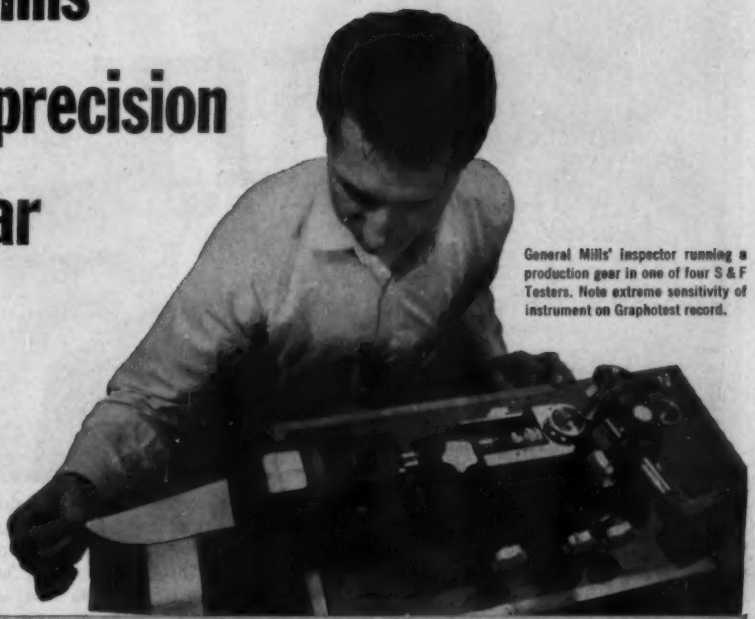
ULTRASONIC IMPACT GRINDER, Model 2-333, can machine an area up to 1⅜ in. in diameter. It incorporates an air-cooled 300-w magnetostrictive transducer that provides continuous operation—*Raytheon Co, Commercial Apparatus & Systems Div, 1415 Providence Turnpike, Norwood, Mass*

MORE DATA? Circle 65, inside back cover

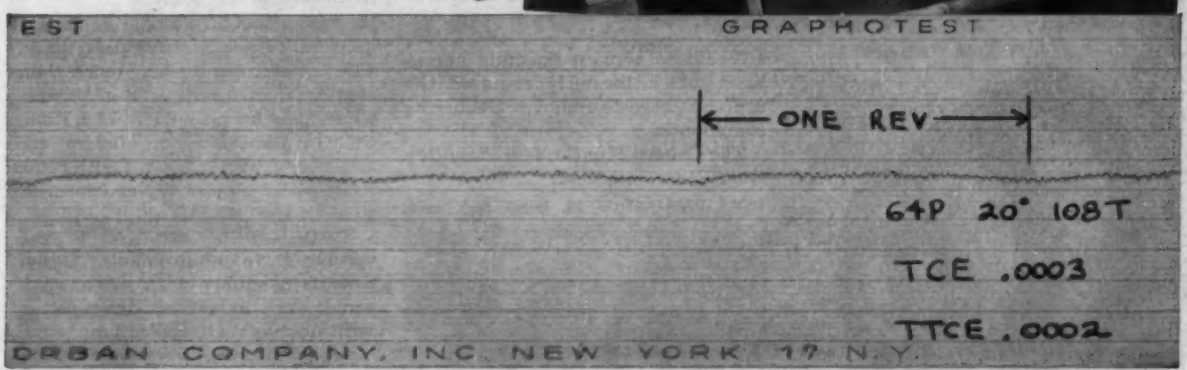
RECIRCULATING FURNACES can be used for annealing, tempering, and stress relieving of both ferrous and non-ferrous alloys in operating temperature range of 300 to 1400 F. Pit model (left) and box model come in seven standard sizes with gas-fired or electric heating—*Sunbeam Equipment Corp, Meadville, Pa*

MORE DATA? Circle 66, inside back cover

why General Mills checks every precision production gear on the S&F gear tester...



General Mills' inspector running a production gear in one of four S & F Testers. Note extreme sensitivity of instrument on Graphotest record.



because...

there's no gear tester as accurate as the S & F

Checking gears by the usual methods just isn't accurate enough to satisfy so precision-minded a producer as the Mechanical Division of General Mills. They know that their gears can be only as accurate as the instruments that test them—and only the S & F Gear Tester measures up to the highest precision standards.

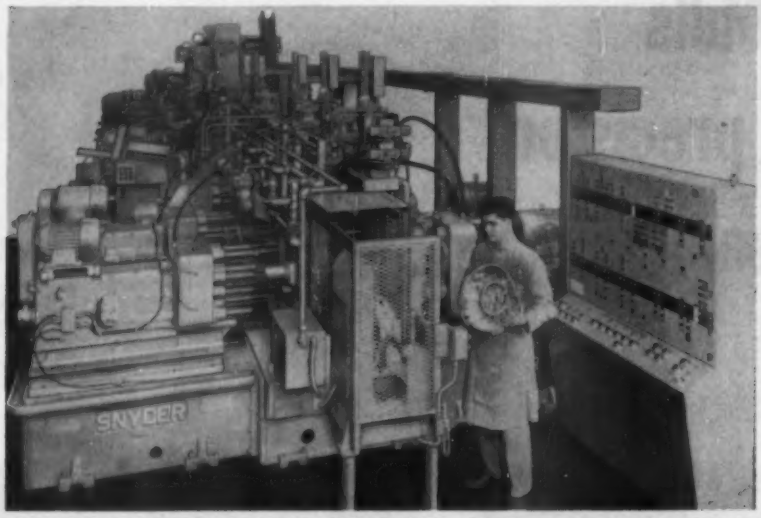
Strong statement you say? Several hundred S & F Testers prove it every day in plants that took their gear accuracy seriously enough to change over to S&F—guaranteed to repeat within .00001".

Ask us to show you why this instrument is revolutionizing gear checking. Or talk to the S & F user near you. We'll send you his name.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN COMPANY, INC.

36 Exchange Place, Jersey City 2, New Jersey



SPECIAL 56-STATION, 114-FT LONG, building block transfer machine drills, tap, spotfaces, mills, bores, and assembles a bushing and stamped rectangular cup in aluminum automotive torque converter case covers. Both large and small covers are processed at a rate of 150 pieces per hr—*Snyder Corp, 3400 E Lafayette, Detroit 7, Mich*

MORE DATA? Circle 67, inside back cover

Line of Precision Finishing Tools Comes in 4 to 12-in. Dia

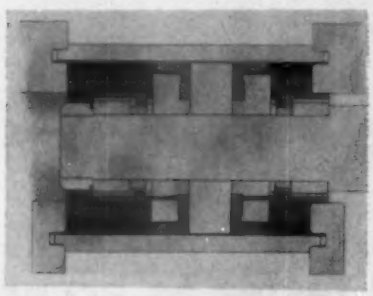
Master Blend precision power finishing tools, available in wheel diameters of 4 to 12 in., give the efficiency of blended, straight wire cutting points, encapsulated in a plastic bond to precisely control finishing action. Edge blends can be held to extremely close tolerances, making possible production finishing of pump gears and similar parts requiring 0.005-in. edge blend.

It is expected that the new tools will see extensive service in a wide range of operations removing burrs and blending edges of ferrous and non-ferrous fine pitch gears, removing flash of plastic parts, producing close tolerance edge blends on clad metal products, and burr removal and edge blending of powered metal parts.

In many instances, the new tools are said to replace finishing operations which formerly required the use of hard-to-remove deburring compounds.

The Osborn Mfg Co, 5401 Hamilton Ave, Cleveland, Ohio

MORE DATA? Circle 68, inside back cover



Hydraulic Cylinder Line Now Equipped With Floating Cushion

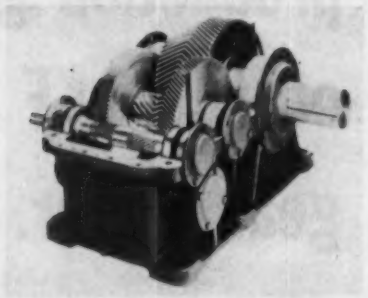
A patented, high-speed, self-regulating, floating cushion is now available on the complete line (1½ through 14-in. bores) of hydraulic cylinders. This new cushion permits much faster cycling than ever before possible on cushioned hydraulic cylinders, according to the manufacturer.

The cushion plunger has a thin-wall, floating sleeve which automatically adjusts itself to trapped pressure under varying deceleration conditions. Thus, even at very high speeds, shock and pounding are eliminated because, as trapped pressure rises, sleeve compression increases to provide greater plunger clearance.

For slow speed cycling, the sleeve automatically re-adjusts to full diameter to keep clearances to an absolute minimum, thus assuring effective cushioning at slow speeds.

Miller Fluid Power Div, 7N015 York Rd, Benseville, Ill

MORE DATA? Circle 69, inside back cover



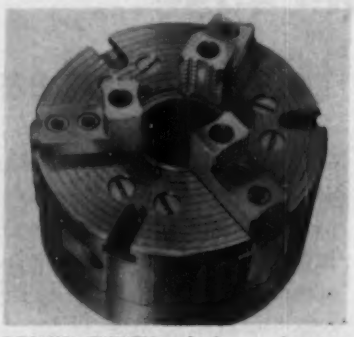
Parallel Shaft Speed Reducers Available in 57 Sizes

Line now includes single reduction units in 17 sizes with ratios up to 9.78:1 and capacities to more than 2800 hp; double reduction in 20 sizes with ratios from 11.4:1 to 70.6:1 and capacities to more than 1700 hp; and triple reduction in 20 sizes with ratios from 31.4:1 to 292:1 and capacities to more than 900 hp.

Shafts can be arranged to suit specific drive requirements. Design permits assembly with single shaft projections in either direction or with double shaft projections.

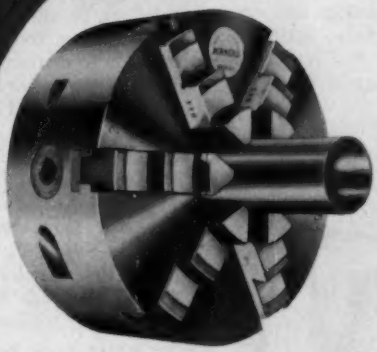
Link-Belt Co, Prudential Plaza Chicago 1, Ill

MORE DATA? Circle 70, inside back cover

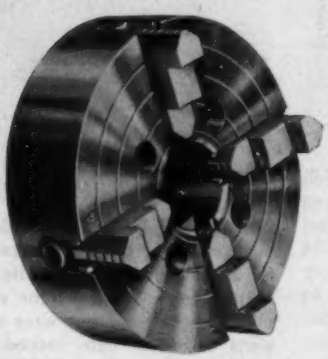


POWER CHUCK, which can be operated either by air or hydraulic cylinder, gives advantages of hand-operated chuck plus controlled holding pressure. It comes in 7 standard sizes from 4¼ to 16 in., in both 2- and 3-jaw styles, with seats to mount directly on spindle of most popular lathes—*Power Grip, Inc, Rockfall, Conn*

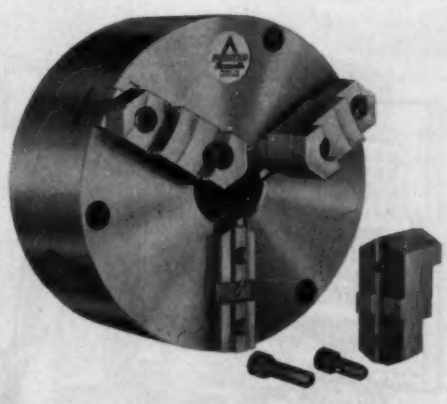
MORE DATA? Circle 71, inside back cover



BURNERD GRIPTRU CHUCKS
3- and 6-Jaw, 4" to 12" Diameter
Chucks work to within .0002" at scroll chuck speed.



BURNERD INDEPENDENT CHUCKS
4-Jaw, 3¼" to 28" Diameter



BURNERD UNIVERSAL CHUCKS
3- and 4-Jaw, 4" to 24" Diameter
3-Jaw chucks are available with either two-piece jaws or two sets of solid jaws.

When you buy BURNERD CHUCKS you save as much as 30%

Built to uncompromisingly high standards of accuracy . . .

Guaranteed against defects in material and workmanship for a period of *two* years . . .

Backed by the coast-to-coast sales and service organization of Clausing . . .

Burnerd chucks are still so economically priced that they save you 20%—even 30%. For example:

A 6" Universal chuck costs only $78.50—a 12", only $180.00

A 6" 3-jaw GRIPTRU—which chucks duplicate parts to within .0002"—costs only $96.00

14" four-jaw Independent is $136.00!

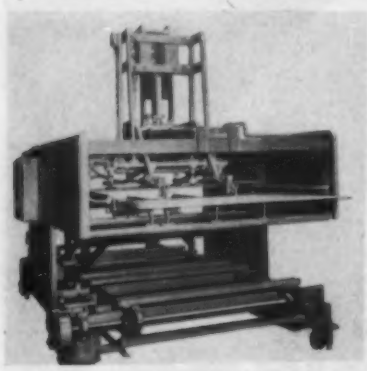
Burnerd chucks are available for direct mounting to long taper or D-1 cam-lock spindles, or for backplate mounting.

SEND FOR LITERATURE TODAY

355

BURNERD CHUCKS

CLAUSING DIVISION
ATLAS PRESS COMPANY
11-202 N. PITCHER ST. • KALAMAZOO, MICH.



Vacuum Cup Destacker Adapts To Leveller, Shear, Applicator

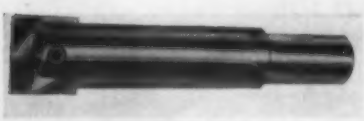
This automatic vacuum cup destacker will lift one sheet at a time from the top of a stack of blank sheets, index forward, and deposit the sheet on the feed station. The lifter mechanism then returns and picks up another sheet. As this sheet is indexed forward to the feed station, pushers—attached to the lifter mechanism—push the previously loaded sheet from the feed station through a double sheet detecting safety device into a punch press, shear, roller leveller, roller applicator, or other machine.

When pallets are used, the stock index conveyor is built with an empty pallet removal station. After the first pallet has been completely destacked, the index conveyor moves the next full pallet into the destacking position.

The destacker is completely self-contained, floor-mounted, does not require a pit or foundation, and includes both automatic cycling and manual inching controls, as well as sheet separator. It is made in various sizes and arrangements to suit any particular application.

Die & Automation, Inc, 5353 Dixie Hwy, Hamilton, Ohio

MORE DATA? Circle 72, inside back cover



Flat Bottom Spade Drills Available With Up to 5-in. dia

Designed for quick insertion in the standard Waukesha spade drill holder, flat bottom spades from 1 in. in diameter up to and including 5 in. in diameter are available as standards.

Manufacturer claims that blind holes can be machined in less time and blades can be changed without removing drill holder from the machine. The cost of the flat bottom blade is quoted at less than half the cost of reworking a twist drill. In addition, blades can be furnished with corner radii to customer specifications.

Waukesha Cutting Tools Inc, Dept 14, PO Box 11, Waukesha, Wis

MORE DATA? Circle 73, inside back cover

Automatic Screwdriver System Drives 7000 Fasteners an Hour

New automatic equipment — which sorts, meters, and installs all types of screws, pins, bolts, rivets, and studs from ⅛ to 2¼-in. long No. 14 screw at rates as high as 7000 per hour—consists of a compact (12 x 14 x 27-in.), specially designed hopper unit with positive electrical switch-controlled feed and a standard power screwdriver. The driver is pneumatically fed, at 40 psi, through plastic supply hoses and equipped with a self-centering bit and clamping tip of patented design.

In operation, the screw itself acts as a pilot to center the screwdriver.

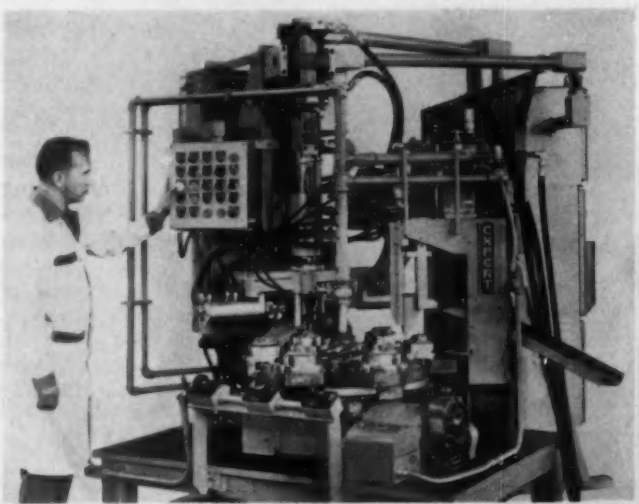
Up to 12 screwdrivers may be efficiently operated from one hopper, and operators may work on a radius up to 50 ft from the hopper with normal shop air pressure. Hopper may be monorail-mounted to follow the workers, or the system may be set for fully automatic production line service.

Clyde Engrg & Mfg Corp, 937 E Ten Mile Rd, Madison Heights, Mich

MORE DATA? Circle 74, inside back cover

UNIVERSAL CALIPER WRENCH has jaw capacity range from zero to 1½ in. Slide cam jaw is operated by one finger. Engraved indicator scale permits user to read nut sizes or dimensions of other item locked between jaws—*Custanite Corp, 1228 Utica Ave, Brooklyn 3, N Y*

MORE DATA? Circle 75, inside back cover



SIX-STATION ROTARY INDEX AUTOMATED WELDING machine projection welds an automobile horn motor field coil cup to a base plate at a production rate of 1000 assemblies an hr. Automatic air operated holddown fixture maintains proper height between flange of base plate and face of cup during welding operation—*Expert Welding Machine Co, Div of Expert Die & Tool Co, Inc, 17144 Mt Elliott Ave, Detroit 12, Mich*

MORE DATA? Circle 76, inside back cover

DEPENDABLE . . . predictable response to heat treatment every time

Send for Bulletin 102— "Helpful Heat-Treating Hints."

The full uniformity within each bar of Desegatized FM die steel and the consistent uniformity from lot to lot simplifies the heat treatment of your die components. Predictable hardnesses are readily attainable . . . distortion and size change are minimized . . . danger of cracking is lessened!

In free machining FM die steels, full uniformity is achieved through Latrobe's unique Desegatized process of manufacture. This process guarantees an even distribution of carbide particles, free machining alloy sulphides and other alloying elements . . . factors leading to improved machinability, greater toughness and improved wear resistance in addition to the optimum heat-treating characteristics.

Latrobe's 12% chromium FM die steels are available through district steel service centers near you. Grades include: Olympic FM (Type D-2) for long-run applications; GSN FM (Type D-3) non-deforming die steel; Cobalt Chrome FM (Type D-5) for extra resistance to galling and pickup.

Call your Latrobe representative today!

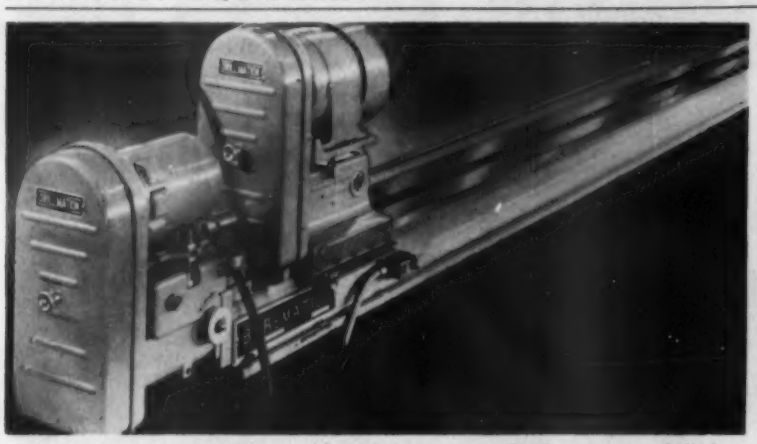
Manufactured by skilled American labor

LATROBE Metalmasters

LATROBE STEEL COMPANY

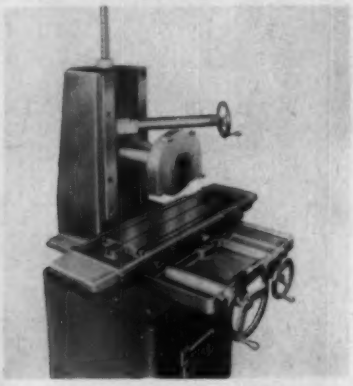
LATROBE, PENNSYLVANIA

BRANCH OFFICES and STEEL SERVICE CENTERS: BOSTON • BUFFALO • CHICAGO CLEVELAND • DAYTON • DETROIT • HARTFORD • LOS ANGELES • MIAMI • MILWAUKEE NEW YORK • PHILADELPHIA • PITTSBURGH • SAN LEANDRO • TOLEDO



HEAVY DUTY GUN-DRILLING and boring power unit, the Boremation, drills long holes ranging up to 60 in. long and 3-in. diameter. These holes can be gun-drilled from the solid, in one pass, on a production schedule. Variable feed rate is adjustable from 0.0001 to 30 ipr; spindle speeds, variable up to 10,000 rpm, can be matched to any feed rate—*Drillmation Co, 6500 E 11 Mile Rd, Center Line, Mich*

MORE DATA? Circle 77, inside back cover



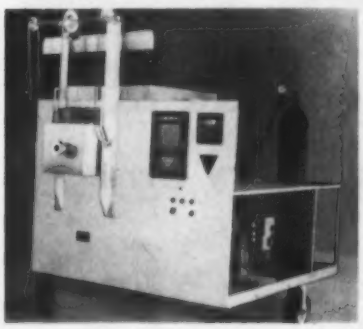
King Precision Surface Grinder Does Wet or Dry Grinding

Manually controlled Model K-1020, which does either wet or dry grinding, has a longitudinal table travel of 20 in., and a 14-in. cross feed. Grinding wheel diameter of 12 in. allows a 15-in. vertical clearance over the table, which has T-slots and travels on precision ground ways. Table has a 10 x 20-in. working surface when used for wet grinding.

The grinder has a direct-drive spindle which rotates on pre-loaded precision ball bearings, and is powered by a 1½ hp balanced motor.

King Machine & Mfg Co, 1171 E 32nd St, Los Angeles 11, Calif

MORE DATA? Circle 80, inside back cover



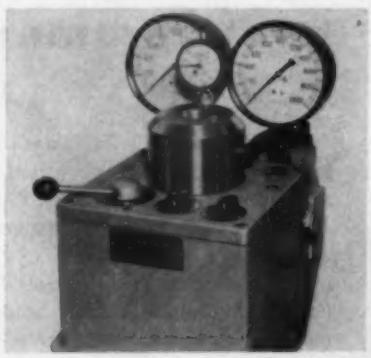
Portable Electric Furnace Operates at 2900 F

Pereco Series FGKS is suited to all areas of heat treating (metal or ceramics) calling for sustained temperatures up to 2900 F in normally oxidizing atmospheres. It incorporates molybdenum disilicide (Kanthal Super) elements. Furnace and instrumentation panel are mounted on a common base equipped with large pneumatic tired wheels.

Work area is 10 in. wide x 30 in. deep x 10 in. high. Hearth is pure aluminum tile. The case is all welded steel, gas tight, and has 7½-in. lightweight insulating brick plus 2 in. of solid block Super X for total of 9½-in. insulation. Door is counterbalanced and crank operated and is provided with adjustable stops for setting the desired open position. Temperature controls consist of a strip chart recording controller complete with a saturable core reactor package with current limiting device. A reset-type indicator with automatic temperature shut-off is also provided. Power rating is 26 kw 220/60/1

Pereny Equipment Co, Chambers and Pereco Sts, Columbus 12, Ohio

MORE DATA? Circle 78, inside back cover



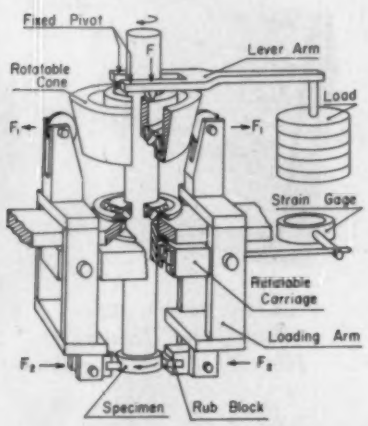
Ductility Testing Machine Handles Foil and Thin Sheet Metal

Designated the Thin Sheet Metal and Foil Tester (Model TSD), the machine is designed to permit quick, accurate readings for both experimental and production work. Gripping pressure and movement of test piston of the machine may be adjusted to different levels independently of each other so as to fit whatever test conditions are desired. Tests are carried out in full view of the operator.

Unit is available in five gage calibrations ranging from 200 to 2000 lb for work from 0.002 to 0.020-in. maximum thickness.

Detroit Testing Machine Co, 9390 Grinnell Ave, Detroit 13, Mich

MORE DATA? Circle 79, inside back cover



A-6 TESTER can be used for simulation of most types or combinations of wear, heat, and atmospheric conditions to evaluate ring and cylinder wall wear, bearing wear and friction, and to determine wear characteristics of all types of metals and alloys. It can also be used for friction measurement of solid lubricants, plastics, and fibrous materials as well as oils and grease—*Hohman Plating & Mfg, Inc, 814 Vermont Ave, Dayton 4, Ohio*

MORE DATA? Circle 81, inside back cover

Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Plastic grille for air conditioner molded

IN A BREEZE

with Lustre-Die

This plastic grille for an air conditioner was molded at the rate of one per minute by Midwest Plastics Corporation, Wichita, Kansas. Using a die made of Lustre-Die tool steel, they produced a perfectly formed grille, with a high sheen. The grille measures 21½ x 15 in., and is ½ in. thick.

Why Lustre-Die is ideal for plastic molders

Lustre-Die tool steel is ideal for plastic molders because it can be put right to work, without the need for heat-treatment. It's easy to machine, and it polishes beautifully . . . making possible an eye-appealing sheen on finished plastic parts.

Lustre-Die is an electric furnace steel. It has a well-balanced basic analysis. By adding a special alloy fortification, which increases its depth of hardenability, its fine mechanical properties are further improved. Because Lustre-Die is heat-treated in the mill by means of oil-quenching and tempering, it comes ready for machining and polishing. It is also carefully controlled during manufacture to insure freedom from porosity.

You can always count on a fine molding job when you use Lustre-Die. But don't take our word for it. Put Lustre-Die to work in a trial run. Your Bethlehem tool steel distributor can supply you.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

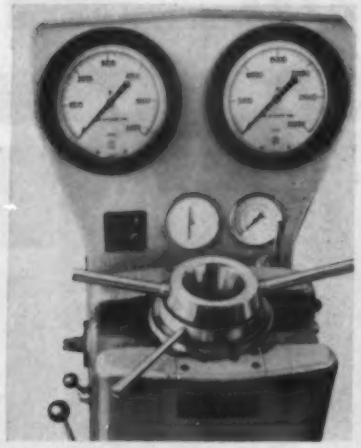
Watch Out for Abrasion Caused by Scale

When punch-press operators are occasionally unable to obtain the required sheet stock in the usual cold-finished form, they substitute hot-rolled stock. However, this causes the service life of the punches and dies to drop to one-half or one-third of normal, or less. This result is largely due to the abrasion of the scaled hot-rolled surface on the cutting edges of the tools. Determining whether such a substitution is economical depends upon the results which are expected, and the cost, of each individual job.

One frequently hears the question: "What can be done in tooling to avoid this decrease in production?"

When punches and dies are normally made from water-hardening carbon tool steel (W-1 or W-2), or from manganese oil-hardening steel (O-1), the shortening of tool life can be avoided by changing to a high-carbon high-chromium tool steel, such as Bethlehem Lehigh H (D-2). This change usually overcomes the disadvantage of using the hot-rolled scaled stock.

However, if high-carbon high-chromium grades are already being used, there is only one method by which an appreciable improvement can be realized—the use of special heat-treatment operations. Typical treatments are short-cycle hardening, and nitriding. Complete details regarding these types of treatment may be obtained by writing Bethlehem Steel Company, Bethlehem, Pa.



Sheet Metal Testing Machine Simulates Actual Deep Drawing

With this Ductomatic sheet metal tester, the ductility or forming quality of sheet metal can be predicted with a high degree of accuracy, because the machine simulates actual deep drawing press operations. Scrap losses are reduced to a minimum, and life of dies is prolonged by rejecting defective material before it is formed.

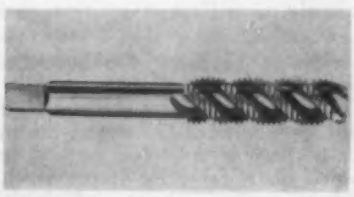
Previously, ductility testing has been limited to pressing a ball into a mechanically held metal sheet until it ruptures. The effectiveness of this indentation test is increased by infinitely variable hydraulic clamping pressure.

By substituting the interchangeable plunger and dies, the Ductomatic can also be used for deep draw cupping tests, hole expansion tests, optimum clamping pressure determinations, and electrical lacquer tests for studying the adhesion and flexibility of lacquer or paint finishes.

These testers are available in capacities from 12,000 to 70,000 lb.

Tinius Olsen Testing Machine Co, 506 Easton Rd, Willow Grove, Pa

MORE DATA? Circle 82, inside back cover

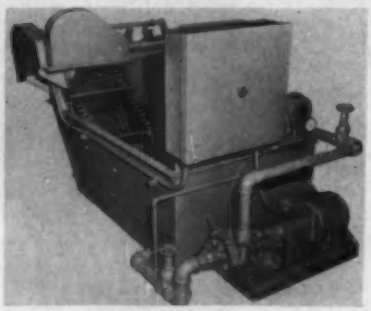


Morse Introduces Line of Taps For Hard-to-Machine Materials

Hi-Helix line features efficient removal of chips and eliminates broken taps caused by clogged flutes. Company claims that the new tap will make smooth, accurate threads to the most exacting tolerance, even in deep holes interrupted by slots or keyways. Line is available in all regular sizes from No. 3 through ½ in.

Morse Twist Drill & Machine Co, 163 Pleasant St, New Bedford, Mass

MORE DATA? Circle 83, inside back cover



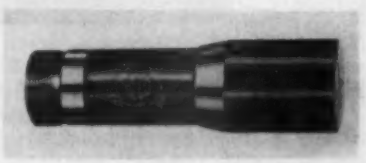
Automatic Filter Available In Capacities From 25-2500 gpm

Self-cleaning, automatic suction filter for salvaging of coolant or waste material in metal working operations eliminates the need for paper or other replaceable media.

Dirty coolant is pumped through a screen into a clean compartment for re-use. Swarf, metal particles, and dirt collect on top of the screen forming a filter mat which filters progressively to low micron particle size. As the filter mat becomes deep enough to decrease the flow of filtered coolant, a switch is activated which starts the conveyor. This moves the mat, clearing a portion of the screen and restoring the flow of filtered coolant to normal rate.

Henry Mfg Co, 516 E Reed St, Bowling Green, Ohio

MORE DATA? Circle 84, inside back cover



Hughes One-Piece Expanding Arbor Has Machinable Head

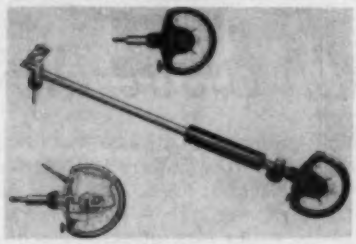
On-The-Ball expanding arbors may be used in any machine or fixture equipped with a standard 5C spindle nose and operated by a lever action collet closer. Currently available with a 1½-in. dia machinable head, the arbor may be used for all cutting operations.

For internally threaded jobs, the arbor may be threaded, the workpiece screwed onto the arbor, and the arbor expended. Also, the arbor may be machined into many other shapes and sizes for special jobs. It may be turned to a minimum diameter of 3/16 in.

The patented tool works on a unique principle; arbor fingers expand on a ball to deliver maximum surface engagement to the work's internal surface. This action insures perfect concentricity and completely controllable gripping pressure.

Hughes Engineering Co, 1658 Superior Ave, Costa Mesa, Calif

MORE DATA? Circle 85, inside back cover

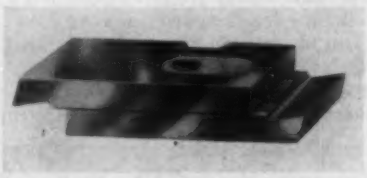


Mahr Self-Centering Bore Gages Have Interchangeable Heads

These precision comparator gaging heads—which read directly in 20 millionths, 50 millionths, or ½-thousandths of an inch—may be interchanged in any Mahr bore gage set within range from 0.059 to 32.00-in. diameter. Only one gaging head has to be purchased for all sets, since it fits all ranges.

Mahr Gage Co, Inc, 274 Lafayette St, New York, NY

MORE DATA? Circle 86, inside back cover



Floating Reamer's Design Doubles Normal Tool Life

Utilizing a method of extending the cutter blades, the Doublifer, after a normal amount of cutter life, can be extended for an equal time.

Reamer does not have to be circle ground as do other types of cutters; the two cutting edges are easily ground and then set to the size desired. Tolerances can be held to 0.0005 in. and the finish produced is from 50 to 100 rms.

Madison Industries Inc, PO Box 1137, Providence, RI

MORE DATA? Circle 87, inside back cover

A COMPLETE GEAR PROGRAM

TO ASSURE YOUR PRODUCT'S EFFICIENCY

Whenever you have a gear problem—any gear problem—consult Illinois Tool Works for the right answer!

From transmissions to turbines—from radar antennas to atomic reactors—if your product requires gears or gear trains, Illinois Tool Works has the experience, skill and facilities to solve your gearing problems.

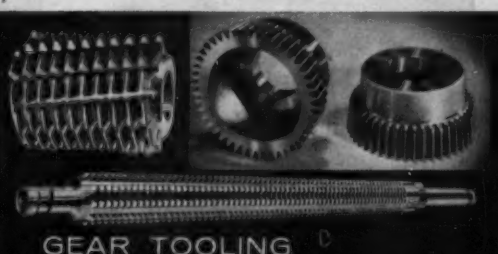
Gear users and gear producers are now offered valuable assistance in gear analysis, gear design, prototype and model manufacture, gear tooling and quality control. This complete program is available to help you improve product efficiency and economy to strengthen your competitive edge.

As a proven advisor to the Army, Navy and scores of power-product manufacturers, Illinois Tool has gained the background and engineering know-how to accurately analyze your gearing problem and to recommend the most satisfactory solution for your specific requirements. This service even includes training your personnel.

Write Today for your "Gear Technical File"

GEAR QUALITY CONTROL

Gear specialists at Illinois Tool have developed gear measuring instruments, ranging from simple hand rolling fixtures to fully automated final-gear inspection machines. Among these are units capable of mechanically inspecting hundreds of gears per hour for all known elements and sorting them categorically. Whatever your quality control requirements let Illinois Tool recommend the system best suited to your needs.



GEAR TOOLING

Illinois Tool Works hobs, shaper cutters, broaches and gear cutters are used to produce thousands of gears daily. They are specified by nearly every major gear producer in the country—proof of their quality, efficiency and economy.

INSPECTION

ANALYSIS AND DESIGN

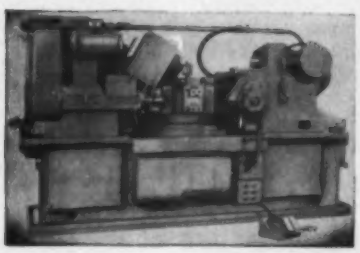
PROTOTYPES

EMPLOYEE TRAINING

GEAR SERVICES

Illinois Tool Works maintains (a) a complete atmosphere-controlled laboratory fully equipped for analyzing and inspecting gears, gear trains or gear-like parts; (b) an engineering staff to design and or recommend gear drives; (c) development facilities to produce models and prototypes; (d) a process group to detail production and quality control procedures; (e) employee training for your personnel which includes a highly concentrated classroom-and-shop course in gear engineering, production and quality control.

ILLINOIS TOOL WORKS
TOOL & INSTRUMENT DIVISION
2501 North Keeler Avenue • Chicago 39, Illinois
In Canada: CITCO DIVISION, CANADA ILLINOIS TOOLS, Ltd., Don Mills, Ontario



GOSS and DE LEEUW
AUTOMATIC
CHUCKING
MACHINE

When any of the various functions for which this machine is designed are performed on it, no further machining is required. The job is finished.

The basic "1-2-3" method . . . exclusive with Goss & De Leeuw . . . provides for gripping work in the chuck and machining all ends either simultaneously or in sequence. By eliminating several handlings and set-ups, the "1-2-3" method produces finished pieces at a fraction of the time and cost ordinarily required.

Send samples of your work for time estimates. Ask for illustrated literature containing detailed information.

GOSS & DeLEEUW
QUALITY PRODUCT-QUANTITY

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

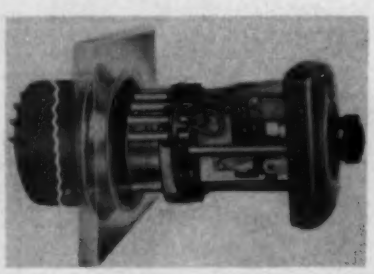
Burgmaster Screw Tapping Head Gives Better Quality Finishes

Leadmatic lead screw tapping head is said to greatly improve the finish and accuracy of tapped threads, and at the same time to eliminate scrap due to pulled or loose threads. The drive runs in ball bearings, and the engagement of forward and reverse motions is through multiple tooth, positive jaw clutches.

Quickly interchangeable lead screws are available for NF and NC threads from ⅛ through 1-in. diameter. The head is sold with one lead screw, lead nut, and tap collet as standard with lead, collet diameter as desired. Especially suited for tapping tough materials and blind holes, the unit is furnished with a timer that allows tapping to depth, and tap retraction from the hole.

Burg Tool Mfg Co, Inc, 15001 S Figueroa St, Gardena, Calif

MORE DATA? Circle 102, inside back cover



Plug-in Timer Has Exclusive Safety and Conversion Features

Because it is easy to replace, this new plug-in dial timer is particularly suitable for industrial processing operations in which downtime on high production machines is extremely costly.

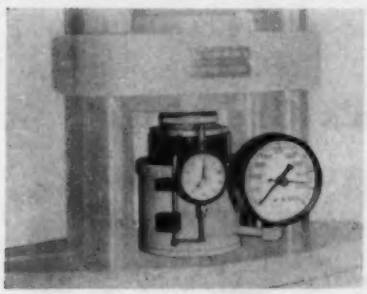
The timer has a keyed guide pin for maximum safety and convenience. This pin, which properly aligns the timer in the case, protrudes through the rear of the plug-in terminal block on the housing, and is drilled to take a snap-in cotter pin clip.

Because thousands of Type 305

timers are already in operation, ATC has designed a field conversion kit which enables these installed units to be converted to plug-in convenience.

Automatic Timing & Controls, Inc, King of Prussia, Pa

MORE DATA? Circle 103, inside back cover

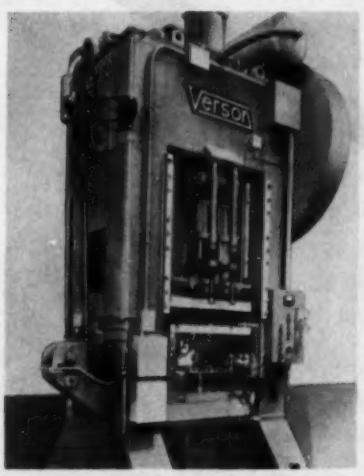


Self-Contained Adapter Converts Compressors to Ductility Testing

Model CTC sheet metal tester cell permits existing compression equipment to be used in making ductility tests on sheet metal up to 1/16-in. thick. The self-contained adapter, which weighs only 22 lb, can be used with a wide variety of compression loading equipment for ball punch and cup type ductility tests.

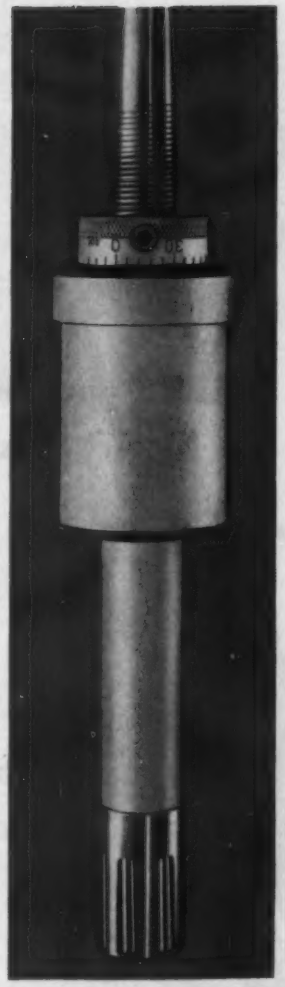
Detroit Testing Machine Co, 9390 Grinnell Ave, Detroit 13, Mich

MORE DATA? Circle 104, inside back cover



DOUBLE TRANSFER FEED mechanism, applied to cold extrusion press, speeds production of automotive wrist pins. Press feeds slugs from single hopper to two Transmat feed mechanisms. In parallel transfer operations, material is moved to each station by mechanical fingers—*Verson Allsteel Press Co, 9300 Kenwood Ave, Chicago 19, Ill*

MORE DATA? Circle 105, inside back cover



WITH THE MADISON microller® BURNISHING TOOL, YOU GET A FINE FINISH – FAST!

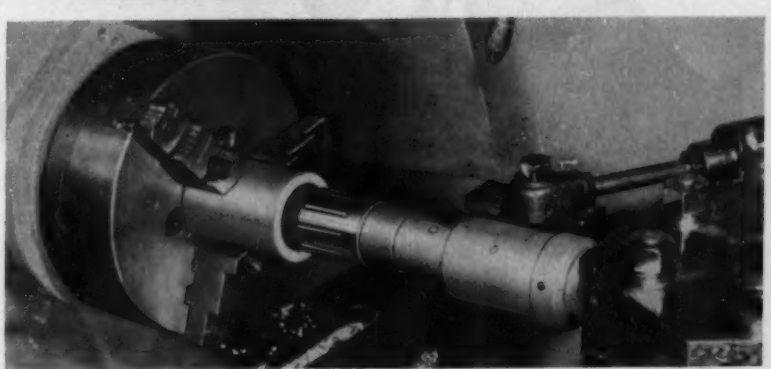
This revolutionary tool finishes rough bored or turned surfaces, of 125 mu. and higher, to 5 mu. and lower at feed rates of 8 to 12 inches per minute.

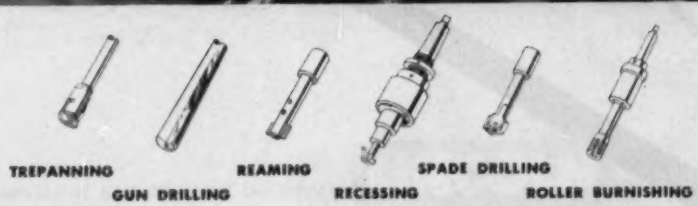
Over 1000 major metalworking companies are continually replacing grinding, honing and lapping operations with the Madison Microller.

Here's why:

- The Microller gives you, in one pass, a finish far superior to any that can be produced with abrasive processes
- You run thousands of parts without tool wear
- No operating skill required
- Can be used in any standard shop equipment
- Finishes any machineable metal—creates a condensed, compacted surface

For additional information, call your Madison representative, or write for our latest bulletin.





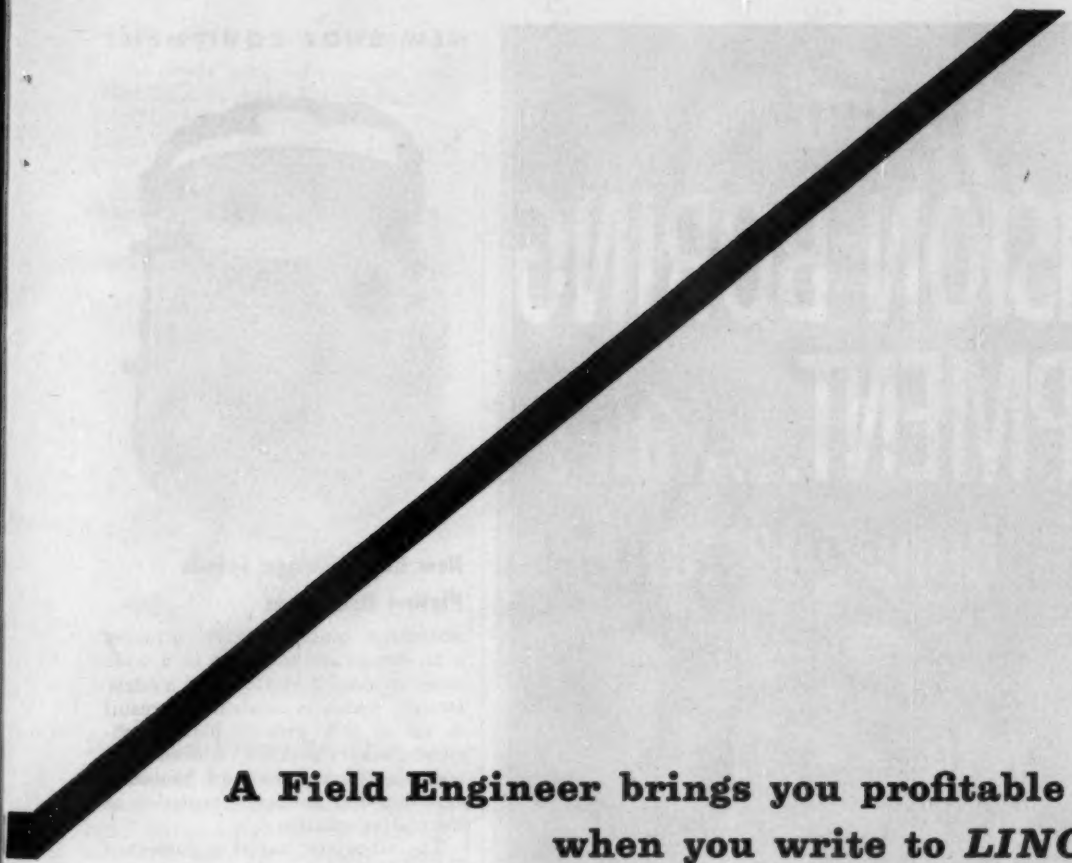
MADISON Industries, Inc.

P. O. BOX 1137, PROVIDENCE, RHODE ISLAND

A reindeer brings you Season's Greetings when you write to

SANTA CLAUS

(specialist in world peace)



A Field Engineer brings you profitable ideas when you write to *LINCOLN*

(specialists in arc welding)

WRITING to Santa Claus is an exciting experience for the whole family. Eager faces . . . pencilled lists . . . crackling fire . . . and the air alive with expectancy. And then the long, almost unending wait until Christmas, when miraculously St. Nick generally delivers even a little more than was desired. This is why we have faith in him. That's the spirit of Christmas!

Now, we don't say our Field Engineers will arrive in sleighs filled with toys, but this we can guarantee: if you write a letter to LINCOLN, the Field Engineer who calls will be able to give you a good deal more help than you expected. Not only does he know welding products but also the best procedure to use on each job. He understands how to relate welding profitably to your total manufacturing operation.

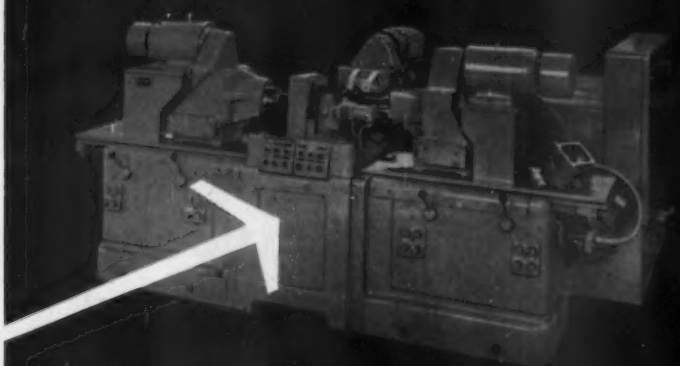
That's why so many companies who have had faith in LINCOLN for over fifty years say, "It's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a 'plus' at no charge."

Merry Christmas!

THE LINCOLN ELECTRIC COMPANY
Dept. 1660 • Cleveland 17, Ohio

LINCOLN WELDERS

PRECISION BORING EQUIPMENT...



precision boring equipment
by America's greatest names...

Here's a money-saving way to handle every precision boring problem—no matter what. We'll take your present machinery or basic equipment . . . completely retool and rebuild it to your specifications . . . install it in your plant under the supervision of one of our service engineers, if you so desire . . . and back up our work with a NEW machine guarantee.

It's quite possible that we already have the machine you need in our present inventory of rebuilt, retooled machines that bear America's greatest names.

No matter which you choose—whether from our inventory or starting with your machinery, we'll accept complete responsibility for your precision boring problem.

Write for complete money-saving details with an up-to-date list of our current inventories.

DEARBORN
MACHINE TOOL DIVISION

DEARBORN TOOL AND DIE COMPANY
10200 Ford Road, Dearborn, Michigan • LU. 2-3636

NEW SHOP EQUIPMENT

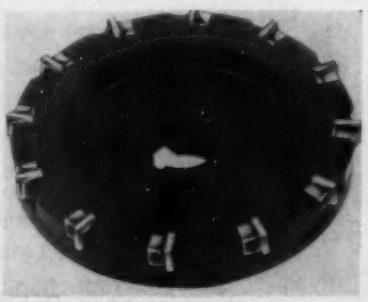
New Barrel Design Speeds Plating Operations

Automatic plating barrels utilizing a fin design are available in a wide range of sizes, materials, and models. Design, which is reported to result in up to 48% greater plating efficiency, makes possible reduced electrical resistance and more thorough agitation and uniform circulation of the plating solution.

The all-plastic barrel is furnished in polypropylene and in copolefin, a special olefin copolymer. They are also available in high-temperature acrylic (Plexiglas) and other materials on special order. Units are interchangeable with standard barrels on automatic plating machines.

Imperial Industries Inc, 4436 Walker Ave, Wayne, Mich

MORE DATA? Circle 106, inside back cover



Wetmore Offers Complete Line Of Standard Milling Cutters

A new line of standard milling cutters with indexable carbide inserts permits immediate renewal of the cutting edges at the machine. Cutters are available in a wide range of standard sizes and styles for shell and mills, face mills, angle face mills, shoulder face mills, and half side mills.

The newly designed line uses precision ground insert blanks that are standard with leading carbide manufacturers and are readily available from local suppliers' stocks.

Wetmore Tool & Engrg Co, 5320 E Washington Blvd, Los Angeles 22, Calif

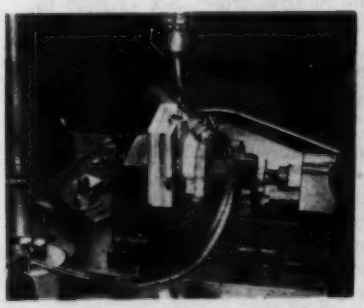
MORE DATA? Circle 107, inside back cover

Seven New Control Valves Introduced by Humphrey Products

Seven new heavy duty, square body valves, which can be operated manually and mechanically, have been designed for use as controls on fine quality machine tools. Valve bodies, levers, and bases are either machined from bar stock or are castings. Parts are said to be fitted to precision tolerances for extra smoothness and durability in service.

Humphrey Products Div, General Gas Light Co, Kalamazoo, Mich

MORE DATA? Circle 108, inside back cover

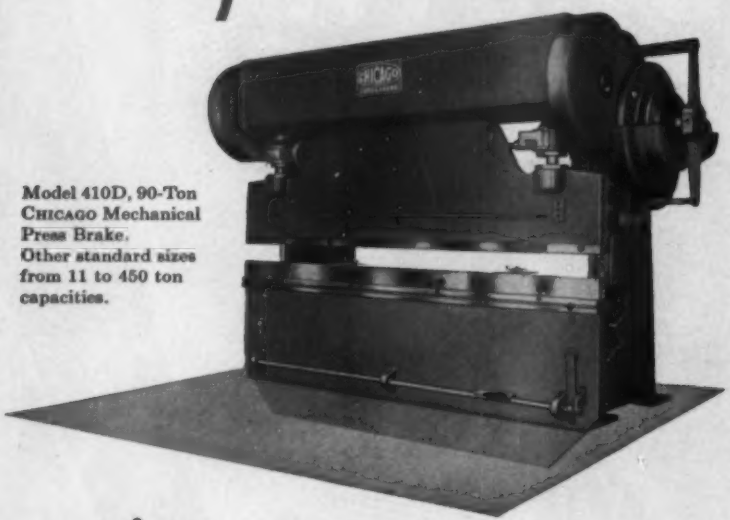


MIST COOLANT SYSTEM, including the Magnatrac adjustable air valve, is available for shops doing grinding, drilling, tapping, and milling. It can be set up in the most workable position and can be transferred from one machine to another. No drain back is necessary—*Future Products Inc, 3725 E 13th St, Indianapolis 1, Ind*

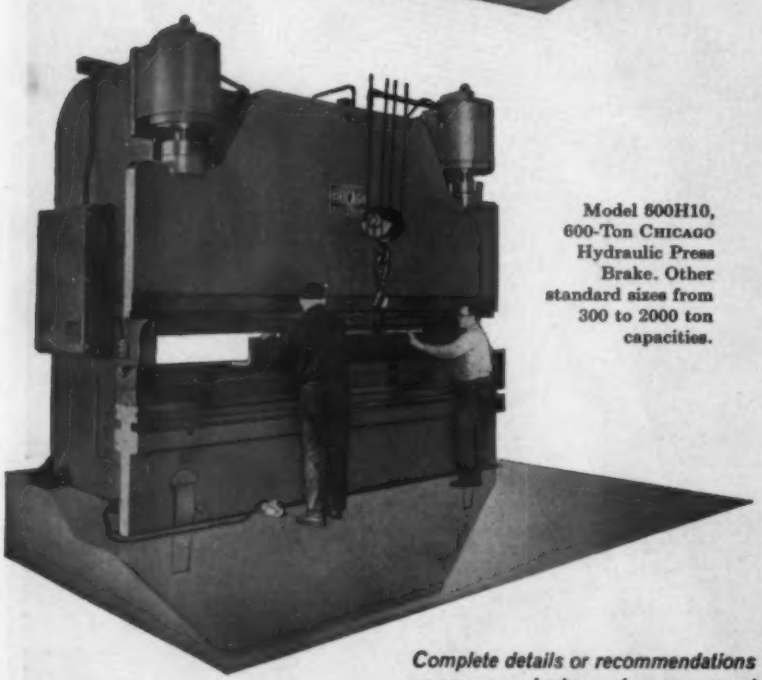
MORE DATA? Circle 109, inside back cover

CHICAGO® PRESS BRAKES

unexcelled accuracy / ***for sheet metal and plate work***



Model 410D, 90-Ton CHICAGO Mechanical Press Brake. Other standard sizes from 11 to 450 ton capacities.



Model 600H10, 600-Ton CHICAGO Hydraulic Press Brake. Other standard sizes from 300 to 2000 ton capacities.

Complete details or recommendations on any press brake work upon request

8470

Press Brakes
Press Brake Dies
Straight-Side-Type Presses
Hand and Power Bending Brakes
Special Forming Machines

CHICAGO DREIS & KRUMP

DREIS & KRUMP MANUFACTURING CO.
7434 S. Loomis Blvd., Chicago 36, Illinois

NEW SHOP EQUIPMENT

Spring (split) collet adapter for use with Chi-Co Quick-Change toolholders takes all A and B Series Chi-Co Super-Flex collets from ⅛ to ¾ in. in 1/32-in. increments. Originally the Quick-Change used solid collets only. Both the solid collets and the new spring collet adapters interchange tools within 0.0005 of indicator settings on all machines in 3 to 5 seconds.

Chi-Co Inc, Northfield, Ohio

MORE DATA? Circle 110, inside back cover

Pushbutton timer, designated Model 309 Atcotrol Timer, provides automatic shutoff and reset and is available for either ac or dc operation. It is furnished in 16 standard dial ranges from 6 sec to 60 hr and can also be provided for special ranges and voltages.

Automatic Timing & Controls Inc, King of Prussia, Pa

MORE DATA? Circle 111, inside back cover

Heavy-duty turret indexing machine chassis provides intermittent motion for multiple-station automatic assembly operaions. Chassis, known as Series H, is a complete package including motor, drive, and clutch; it is intended as a basic unit around which special automatic machines can be designed and built—*Swanson-Erie Corp, 816 E Eighth St, Erie, Pa*

MORE DATA? Circle 112, inside back cover

Laboratory ovens, with heat range up to 1000 F, are accurate to ±½ F and specially adapted to teflon fusing or sintering, aluminum treating, and glass annealing. Six standard models, for either gas or electric operation, come in sizes from 13 x 13 x 13 in. to 48 x 30 x 42 in.—*Despatch Oven Co, 619 SE Eighth St, Minneapolis, Minn*

MORE DATA? Circle 113, inside back cover

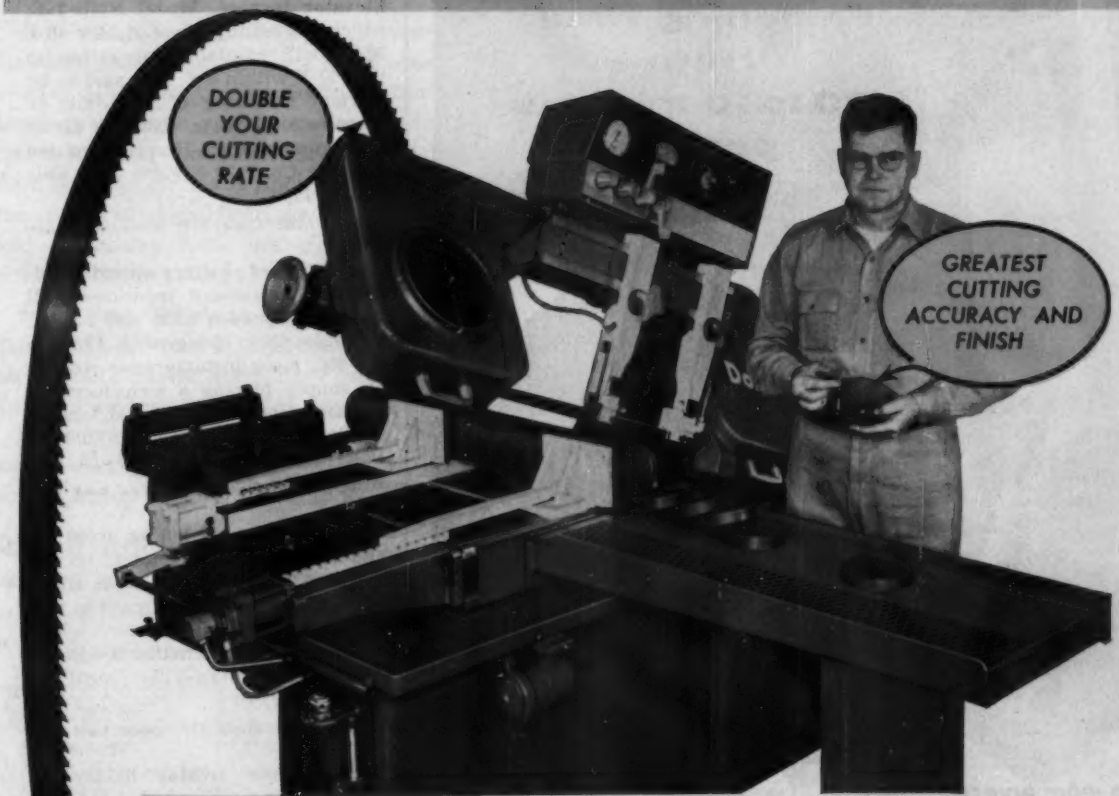
Han-D-Mag lightweight demagnetizer is particularly useful for demagnetizing twist drills, taps, lead screws, and other small parts. Device operates on any 110-v ac line—*Bux Magnetic Products, Inc, 1355 N Tenth St, San Jose 12, Calif*

MORE DATA? Circle 114, inside back cover

Eight rotary swagers, including three sizes of new die closing model, have been added to line, whose 17 models now have capacity for solid materials up to 2½-in. dia and for tubing to 6-in. dia—*Torrington Co, Swaging Machine Div, Torrington, Conn*

MORE DATA? Circle 115, inside back cover

NEW DoALL Machine Tool With NEW Tungsten Carbide Blade



New Cut-Off Rates

MATERIAL	SIZE	DoALL TIME
4340	7" dia.	2.9 min.
1018	6-3/16" dia.	1.25 min.
1020	5" dia.	40 sec.
18-8 Stainless	7" sq.	8 min.
Stentor	6" dia.	3.8 min.
1117	3¼" dia.	27 sec.
1020	6" dia.	1.2 min.
4340	11¾" dia.	8 min.
Ketos	11¾" dia.	8 min.
4140	5½" dia.	2 min.
8620	10½" dia.	7.5 min.
4150	8" dia.	5 min.

Wait till you see this team cut your stock to lengths. It's terrific! With tremendous cutting ability, DoALL's revolutionary TUNGSTEN CARBIDE Saw Band on an entirely new power saw is the team that wins again. It delivers by far the fastest cutting rates ever achieved by any band tool cut-off saw, together with the remarkable accuracy and finish for which the DoALL Power Saw is famous.

Automatically operated, the machine has the power to drive the TUNGSTEN CARBIDE Band up to 450 fpm. It offers broad feed force range, self-adjusting carbide-faced saw guides, automatic chip conveyor, plus many other features.

For lowest cost, highest cut-off productivity, mail us this coupon . . .

PS-18

This is a typical DoALL Store

ASK FOR A DEMONSTRATION TODAY!

THE DoALL COMPANY, Des Plaines, Illinois

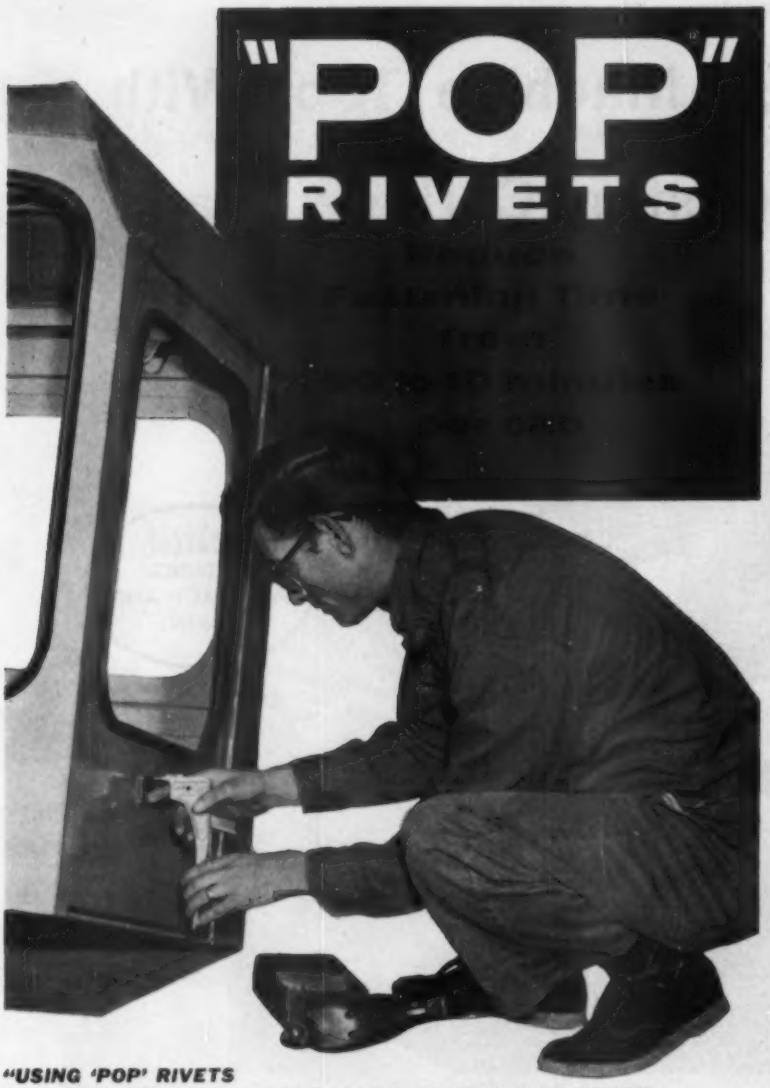
We would like to see a demonstration of the new DoALL C-70 TC Power Saw in our plant—without cost or obligation.

Name_____

Company_____

Address_____

City_____ State_____



"USING 'POP' RIVETS IS LIKE ADDING EXTRA MEN TO OUR PRODUCTION STAFF"

says G. F. Williams, Plant Manager at Industrial Cab Co., Salem, Mass. "And there seems to be no end to the number of jobs which can be done better and quicker with these blind fasteners.

"Because of the wide grip range of "POP" Rivets, problems in joining a variety of material thicknesses have been eliminated. Our fastener inventory has been minimized and instruction time reduced because of the simple installation procedure."

"POP" Rivets are making equivalent savings on boats, metal furniture, appliances, refrigeration and air conditioning equipment, pre-fab houses, truck and trailer bodies and hundreds of other products.

Investigate now the ease with which your company can enjoy the advantages of using "POP" Rivets. Call or write for your personal copy of our new catalog or order the introductory Kit today.

NEW!

LET THIS KIT INTRODUCE YOU TO "POP" RIVETS

The easy way to get started, this introductory Kit contains approximately 240 "POP" Rivets in various lengths and materials together with a hand setting tool. Complete with instructions and application hints. Order today and start saving on fastener costs!

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UNITED SHOE MACHINERY CORPORATION
4711 RIVER ROAD, SHELTON, CONN.
REgent 5-3391

UNITED
"POP"
RIVETS

NEW SHOP EQUIPMENT

Compact honing machine, Model 3010, is available with 25, 35, or 60-in. spindle travel. Machine will hone bores up to 10-in. dia at max stroke, and will hone even larger dia bores in shorter lengths—*Barnes Drill Co, 830 Chestnut St, Rockford, Ill*

MORE DATA? Circle 116, inside back cover

Elevator furnace, Model NMR-24E, which has setting space of 24 x 46 x 30 in., will maintain temperature up to 2700 F within 5 F. It is said to be efficient for firing of electronic or other ceramic parts, either in air or inert atmospheres—*Harrop Precision Furnace Co, 3470 E Fifth Ave, Columbus 19, Ohio*

MORE DATA? Circle 117, inside back cover

Transistorized battery-operated ultrasonic instrument measures wall thickness between 0.025 and 2.50 in. Portable unit, designated Sonizon SO-300, gives instantaneous reading by simply placing a transducer on surface to be measured and turning a dial—*Magnaflux Corp, 7300 W Lawrence Ave, Chicago 31, Ill*

MORE DATA? Circle 118, inside back cover

Rectangular gage blocks 0.050 in. and larger are now etched on the side and clearly visible while stacked. Boxes have been designed to take full advantage of this feature, which clearly shows size whether blocks are in box or removed—*The DoAll Co, Des Plaines, Ill*

MORE DATA? Circle 119, inside back cover

Multi-purpose brazing fixture reduces brazing time needed for even the largest sleeve-collar assembly to one minute. One holding device accommodates different sized work assemblies by use of interchangeable work-coils and adapter fittings—*Induction Heating Corp, Brooklyn, NY*

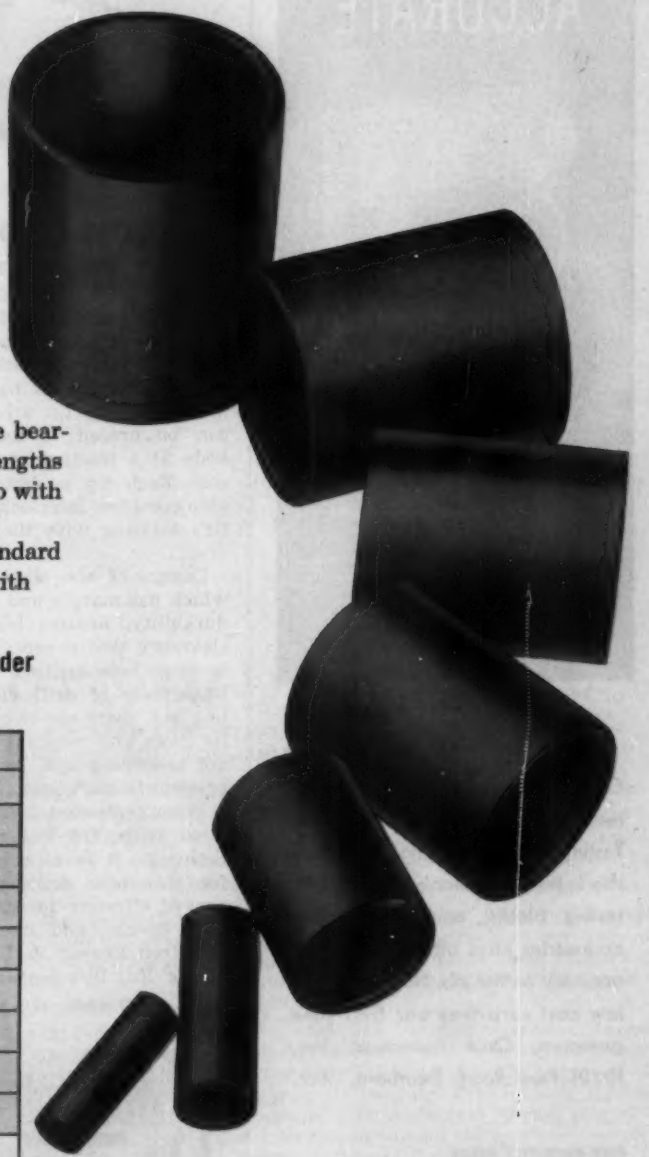
MORE DATA? Circle 120, inside back cover

"I'm sorry about the raise Burrows, but as long as you're down there see if you can find my fountain pen."

Save Dollars By Using Johnson Bronze Standard Stock Bearings

Do you like to pay the added cost for special bearings? Of course not. It doesn't make sense.

But using *low-cost* Johnson Bronze standard stock bearings does make sense —especially when you consider that these bearings will meet your tolerance requirements and allow maximum freedom of design. Johnson standard stock bearings have the quality of special bearings, but the tooling and machining costs are eliminated. You profit from the savings.



More than 900 stock sizes of these plain, whole bearings in 214 different ID-OD combinations and 21 lengths are yours to choose from. They can be supplied also with slots, oil grooves or holes at slight additional cost.

Save money . . . save time with Johnson standard stock bearings. *They make sense.* Get in touch with your Johnson distributor today for fast service.

See how much can be saved on a typical special order by using Johnson Bronze Standard Stock Bearings

Operations Required	10 Bearings 5/16 x 7/16 x 1	
	Special Bearings	Johnson GP Bearings
Rough Bore	Yes	No
Finish Broach	Yes	No
Rough O.D.	Yes	No
Semi-Finish O.D.	Yes	No
Cut Length	Yes	No
Chamfer O.D., I.D. on two ends	Yes	No
Grind	Yes	No
Stamp	Yes	No
Total Cost	$26.40	$9.20
Delivery Date	?	Immediately

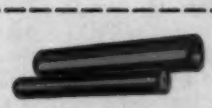
Johnson Bronze Company

New Castle, Pa.

West Coast Plant: Oakland 8, Calif.

GRAPHITED over 175 sizes

GENERAL PURPOSE over 900 sizes



UNIVERSAL BRONZE BARS over 400 sizes

POWDER METALLURGY over 400 sizes

ELECTRIC MOTOR (EM) over 350 sizes

The Most for Your "Rockwell Testing" Dollar!

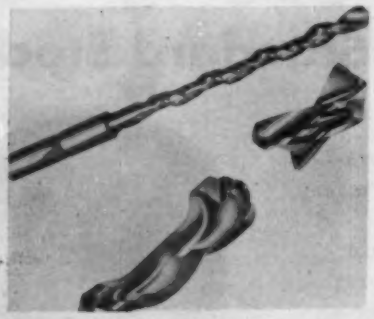
Clark Hardness Testers are *guaranteed* accurate for all "Rockwell Testing". Clark's exacting workmanship in the production of penetrators, testing blocks, anvils, and other accessories pays off in exceptional accuracy on the job. No wonder the low cost surprises our first-time customers. *Clark Instrument, Inc., 10201 Ford Road, Dearborn, Mich.*

FREE REFERENCE BOOK

All information about hardness testing in easy-to-read text with many illustrations. Just write "Send Book" on your letterhead. Description and prices for Clark Hardness Tester and free Hardness Conversion Chart also available on request.

CLARK INSTRUMENT, INC.
10201 FORD ROAD
DEARBORN, MICHIGAN

Missile-Age Accuracy



New Type Oil Hole Drill Is Specially Designed for Aluminum

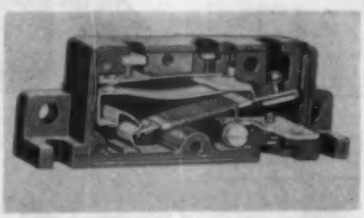
The Bi-Tip drill features two-flute replaceable type available in carbide tipped, solid tungsten carbide, or solid high speed steel. After repeated sharpenings have expended usable cutting tip area, a new tip can be brazed to the undamaged body at a fraction of original drill cost. Each tip is designed to provide complete interlocking and positive locating with the body of the drill.

Design of the single flute body, which has margin and land for high durability, assures maximum chip clearance that is especially effective in deep hole drilling of aluminum. Regardless of drill diameter (5/16 to 1 in.), there are two coolant holes for even and constant flow of coolant to cutting lips. Two hundred lb pressure is sufficient.

When requested, drills will be supplied with Tru-Kut radius points. Although it is especially designed for aluminum drilling, it also has proved effective for drilling in cast iron, bronze, and steel.

Detroit Reamer & Tool Co, 780 W Maple Rd, Birmingham, Mich

MORE DATA? Circle 121, inside back cover



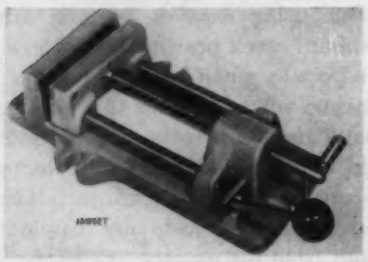
Automatic Motor Protector Gives Pin-Point Accuracy

The design of this automatic-reset circuit breaker or overload relay is based on a new concept to give it pin-point accuracy. Precise calibration is guaranteed by a coordination of bimetal element, heater coil, and infinite contact adjustment.

The device, which will respond to rising temperature and excessive current draw of the motor, can be built into the motor or used remote, either attached to the motor surface or elsewhere. Ratings are from 0.1 to 15 amps.

E T A Products Co of America, 6284 N Cicero Ave, Chicago 46, Ill

MORE DATA? Circle 122, inside back cover

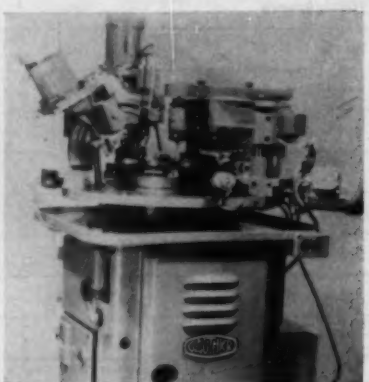


Two Fast-Action Vises Added to Harig Line

Two manually operated vises with locking pressures of two tons and better are offered for light milling, boring, general machine shop or production work. One is called the Jawset and is specially designed for fast production runs. After jaw is set in position an unlimited number of pieces can be run through by a flip of a lever. The other is designated the Rapidset and can be adjusted to any position in a matter of seconds.

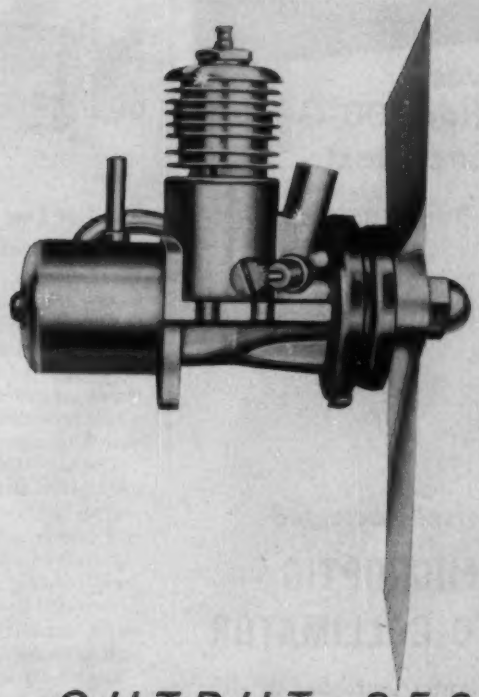
Harig Mfg Corp, 5747 W Howard St, Chicago 48, Ill

MORE DATA? Circle 123, inside back cover



AUTOMATIC ROTARY INDEXING DRILLING AND TAPPING MACHINE, Guthier (German) Model GM 43, features interchangeability of indexing table and workpiece holding fixtures. There are eight working stations. Various spindle speeds are obtainable through exchange of belt pulleys—*Dist by Eric R Bachmann Co, 27-11 41st Ave, Long Island City 1, NY*

MORE DATA? Circle 124, inside back cover



INCREASES TOOL OUTPUT 2500%

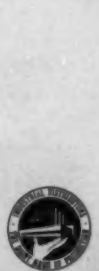
BESLY X-PRESS® TAPS THREAD 101,100 HIGH-COMPRESSION ENGINE HEADS WITHOUT TOOL CHANGE!

Besly X-Press Taps eliminate internal thread cutting . . . speed-form threads quickly and accurately without chips or shavings. Ideal for ductile metals such as copper, brass, aluminum, lead, leaded steel, as well as die castings. Exclusively Besly's and Besly's Licensees', cost-cutting X-Press Taps have already established spectacular records in many mass-production fields. Patent No. Re. 24,572. Other patents pending.

Mass production under strict quality control! . . . 3500 engines daily! That's the output of Wen-Mac Corp. of Los Angeles, a subsidiary of AMF *and* the world's largest manufacturer of quality model aircraft and engines. Here, as in countless other industries, Besly X-Press Taps are reducing the cost of precision.

On two threading operations (.507″ and .590″) on the engine crankcase the X-Press tapped an average of 31,000 parts without tool change. Wen-mac happily reports that Besly X-Press Taps last an average of 31 times longer than the conventional cutting taps formerly used. Tapping their high-compression engine head for a platinum tip glow plug calls for tight fit and freedom from shavings. In this aluminum alloy, X-Press Taps *speed-form* a ¼″ thread in 101,100 volume without a tool change. These internal threads are extra-strong, smoother, and are tapped without chips or burrs. And, X-Press provides more consistent thread gaging, too.

Whatever the tapping requirements, you'll find the right answers at Besly. Phone or write for the complete Besly Tap catalog.



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BESLY-WELLES CORPORATION

120 Dearborn Avenue, South Beloit, Illinois

Grinders and Abrasives • Taps • X-Press Taps® • Drills Reamers • End Mills • Gages • Carbide Tipped Tools, Blanks, Inserts and Holders

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detects angles to .1 second

even after 100-G shock test

universally accepted

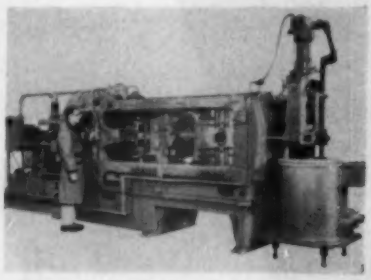
MICROPTIC AUTO-COLLIMATOR

The master instrument to set up and check angles to .1 second over 10 minutes of arc. With simple accessories it establishes squareness, parallelism, flatness, angles, and circular spacing under normal shop conditions independent of distance and temperature. Used as standard for testing of surface plates and machine tool alignment, control of ultra-precision gear cutting devices, test fixtures and tables for missile guidance units.

New . .

The Microptic Auto-Collimator with photo-electric read-out, as original equipment and conversion unit.

ENGIS
EQUIPMENT COMPANY
DIVISION OF ENGINEERING AND SCIENTIFIC INSTRUMENTATION
431 SOUTH DEARBORN STREET
CHICAGO 5, ILL.



450-Ton Zinc Die Caster Has High Ratio of Stroke to Tonnage

This new zinc die casting machine is designed so that it offers twice the die opening of any machine with comparable tonnage. Called the HP-450Z-SF, it delivers 450 tons of clamp, certified by strain gage tests, while providing a die opening stroke which is adjustable from 8 to 30 in.

The HP-450Z-SF, which will produce deep draw zinc parts weighing up to 15¼ lb, has a Lester zinc end which is completely self-aligning and requires only one adjustment for final setup. The system uses a nitrogen accumulator with a 5280 cu in. capacity; stroke of the injection plunger is 9 in.

Lester-Phoenix, Inc, 2711 Church Ave, Dept N-41, Cleveland 13, Ohio

MORE DATA? Circle 125, inside back cover

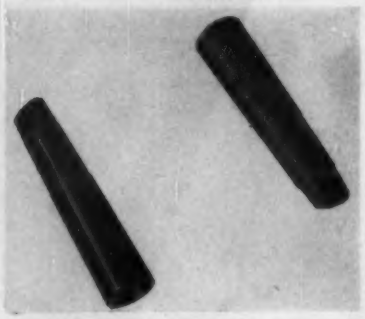
Two Retracting Clamps Added To Newton Hydraulic Tooing Line

Clamps that automatically free the workpiece for vertical loading and unloading have been added to the manufacturer's off-the-shelf hydraulic tooling system. One is the automatic swing clamp. When it is at rest, the arm is 90° away from the clamping position. When line pressure is applied, the clamping arm first swings over the work, then pivots down to clamp. Clamping force exerted by the unit is 900 lb at 2000 psi line pressure.

The other new component is supplied with a stub to which the user can weld clamping tips to suit the application. It can be mounted in any position so it will adapt to almost any fixture. Output of its hydraulic cylinder is 600 lb at 2000 psi, but the force exerted on the workpiece depends on the clamp tip added to it.

Newton Hydraulic Tooling Co, Auburn, Mass

MORE DATA? Circle 126, inside back cover



Nylon Drill Sleeves Available in Two Styles

Red Nylon Drill-Dapter protects new drills, prevents scoring of drill shanks, and allows more accurate drilling production per tool. The White Nylon Drill-Dapter can be used to accurately hold drills with broken or scarred shanks. They have a center hole in tang to make centering and regrinding of damaged drills easy.

Sleeves are available in Morse taper sizes of 1, 2, 3, and 4 (inside taper) and 2, 3, 4, and 5 (outside taper).

American Twist Drill Co, 14311 W Chicago Blvd, Detroit, Mich

MORE DATA? Circle 127, inside back cover

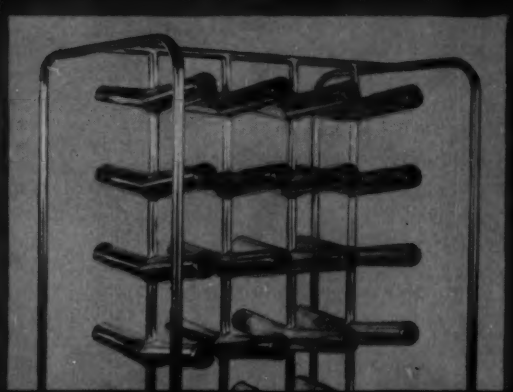
FLY-TOOL CUTTER HOLDER, Fli-Kut, is available in a new model that features a counter-balanced holder. It is furnished in three sizes for ¾-in. shank. Used with 5/16-in. toolbits, it will machine up to 6-in.-wide surface in one cut—*City Tool-Die & Mfg Co, 132 Spencer Ave, San Jose 10, Calif*

MORE DATA? Circle 128, inside back cover

you can bend it...

you can form it...

you can weld it...



but you can never, no never, change its **consistent uniformity!**

...no matter what test you put it to, you'll get consistent performance, greater output, better quality and more profit with Carpenter Specialty Stainless...produced by one of the leaders of stainless steels for industry.

Carpenter steel

you can do it ***consistently*** better with Carpenter Stainless Steels for specialists

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

CIRCLE 398 READER SERVICE CARD

AMERICAN

Mass
Demand
The Automotive Industry requires precise uniformity for mass production. American Twist Drill has satisfied these growing demands for 41 years. Now they are increasing production fast enough to make American Twist Drills available to all American Industry.
Brown & Sharpe
CUTTING TOOLS

American Twist Drill Co.
Detroit, Michigan
Subsidiary of:
Cutting Tool Division
Brown & Sharpe Mfg. Co.,
Providence 1, Rhode Island

AMERICAN

NEW SHOP EQUIPMENT

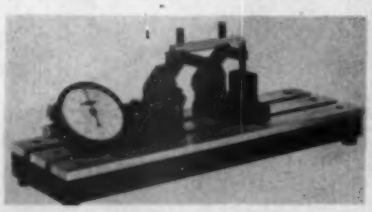
Zero Spindle Inspection Tool Redesigned by Woodworth

New design eliminates conventional bearing errors and guarantees near zero concentricity. Used in combination with company's Push-Type arbors, diaphragm chucks, and Tork-Lok collet arbors, the unit is able to achieve higher efficiency as an inspection tool.

Block assembly design incorporrates a cast bearing block which permits the addition of a small base and tray top for indicator mount assemblies. The journal adjustment feature has been changed to a single screw running parallel with the spindle. A larger wheel and knob assure ease of operation. Zero Spindle bearing block assemblies are available from stock. Concentricity is guaranteed to 0.0001 TIR; specials can be furnished for closer requirements.

N A Woodworth Co, 1300 E Nine Mile Rd, Detroit 20, Mich

MORE DATA? Circle 129, inside back cover



Adjustable Length Gage Speeds Accurate Length Inspection

Measurement of screw machine parts and other machined and ground parts such as shafts and spindles is greatly simplified through use of this instrument. It is easy to set up for inspection work and may be mastered by use of gage blocks or a known size piece part. The bench-mounted gage is adjustable for lengths from ⅝ to 8 in. and for support on diameters from 1/16 to 1¼ in.

Measurements which can be taken include overall length, shoulder to end, shoulder to shoulder, and other combinations. Thread lead may be checked with the use of special contacts. A sensitive reed transfer carries the measurement from the part being checked to the dial indicator. Either coarse or fine measurements may be made depending on the indicator model selected.

Unigage Corp, 330 Interstate Rd, Addison, Ill

MORE DATA? Circle 130, inside back cover

Tube Wall Micrometer Gives Rapid One-Hand Operation

A new micrometer—especially designed to measure tube walls with fast one-hand operation — has a finger-operated dial that spins closed quickly. It is graduated in thousandths with large easily read numbers. A spherical headed lower anvil screw, which is adjustable to compensate for wear, fits flush against the inside wall of the tube; therefore complete accuracy is insured.

Made of nickel plated cast manganese bronze, the micrometer is corrosion-resistant and carries a 30-day moneyback guarantee. It has a ½-in. capacity, and can be inserted up to 1 in. in tubing with an inside diameter of ½ in. or more (1-in. capacity available on special order).

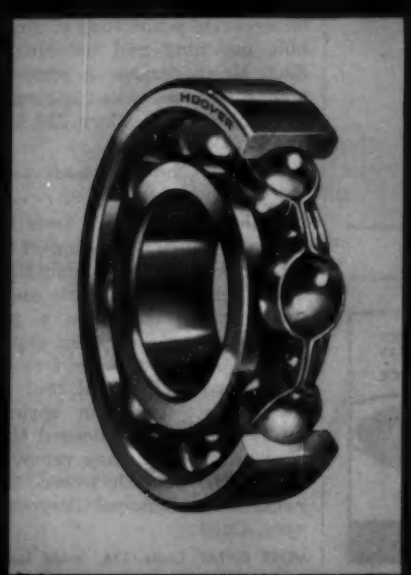
Haines Gauge Co, Inc, Henderson & Shoemaker Rds, King of Prussia, Pa

MORE DATA? Circle 131, inside back cover

SINGLE CIRCUIT CONTACT BLOCK, with convertible terminals, is available separately or with wide selection of type R pushbutton operators, signal lights and knob, key, and coin actuated selector switches as shown on display panel—*Mackworth Rees, Inc, 1573 E Forest Ave, Detroit 7, Mich*

MORE DATA? Circle 132, inside back cover

so quiet...



. . . not even a purr! It's this traditional quietness of Hoover ball bearings that best demonstrates *Hoover Quality* . . . your assurance of longer life, superior performance.

Hoover-Honed raceways are super-smooth, finished to microscopic accuracy. *Micro-Velvet* balls are accurate within millionths of an inch. Precision assembly is achieved through perfect matching of ball complements and raceways. When specifications call for finest quality specify *Hoover Quality* bearings. There is a wide range of types and sizes. Contact your local Hoover bearing specialist, listed in the Yellow Page Directory, or write to us.

Hoover-Honed and *Micro-Velvet* are Hoover Trademarks.

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5400 South State Road, Ann Arbor, Michigan

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290 Lodi Street, Hackensack, New Jersey
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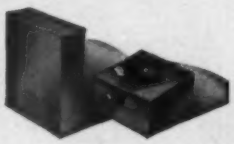

Accuracy, Stability, Wear Life

These are qualities to look for in gage blocks—qualities you'll find finest by far in Ellstrom Chromium Plated Standards. Size, flatness, parallelism unconditionally guaranteed to closer specified millionths than any other blocks you can buy. Made only of time-tested materials fully certified for uniform hardness, absolute metallurgical stability. And gaging surfaces chromium plated by an exclusive Ellstrom process to give you longer wearing millionths, lower gaging costs. Next time you buy gage blocks, be sure you get the very best—be sure to specify

ELLSTROM CHROMIUM PLATED GAGE BLOCKS

MANUFACTURED AND CALIBRATED TO THE INTERNATIONAL INCH—EXACTLY EQUAL TO 25.4 MILLIMETERS

"M" Working Accuracy: +.000005"/−.000000"
Parallelism: .000004" / Flatness: .000004"
"I" Inspection Accuracy: +.000004"/−.000000"
Parallelism: .000003" / Flatness: .000003"
"L" Laboratory Accuracy: +.000002"/−.000000"
Parallelism: .000001" / Flatness: .000001"

Above: Ellstrom Rectangular Set No. 85-R. Left: Ellstrom Square Set No. 81-SA, with accessories.

New Catalog contains prices and specifications—send for it today!

ELLSTROM STANDARDS DIVISION
DEARBORN GAGE COMPANY
22038 Beech Street • Dearborn, Michigan

Originators of Chromium Plated Gage Blocks

*Ellstrom—*Measuring in millionths for three generations*

Hjalmar Ellstrom (1863-1942)—He gave mankind the key to mass production of interchangeable parts. For it was he alone who conceived and produced the world's first combination gage blocks—the first master reference standards accurate to the infinitesimal millionth part of an inch!

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ALL TYPES MADE TO YOUR SPECS!

Contract production; Special automatic machines

A SPECIALIZED CAM MILLING SERVICE
Over 100 Types of INDEXING TURNTABLES

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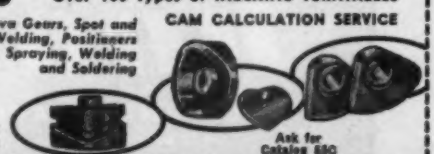


Ask for Catalog 60C

EISLER ENGINEERING CO., INC. | Charles Eisler Jr., President | 730 SOUTH 13TH STREET NEWARK 3, N. J., U.S.A.

NEW SHOP EQUIPMENT

Gearshift drive, Type R3C, 1 through 5 hp, has been redesigned. Lower output shaft speeds are now available, capable of handling severe load requirements. Gear changes (4) are made by a gearshift lever available in four optional positions. Compact design of the combination selective speed transmission and electric motor requires minimum mounting space. Secondary reduction gear ratios range from 1.00 to 2.25. Drive operates on polyphase ac power supplies of standard frequencies and voltages below 600.

Lima Electric Motor Co, Dept 132, Lima, Ohio

MORE DATA? Circle 133, inside back cover

Standard end measures for testing micrometers and maintaining proper adjustment are available in sizes from 1 through 54 in. Sizes up to 12 in. are made from tool steel of 0.312 in. dia; larger sizes through 54 in. have a 7/16-in.-dia body. One end of the measure is lapped flat and square, other end has a spherical radius. Flat end gives a positive locating face and assures proper alignment with the micrometer's measuring terminal.

J T Slocomb Co, 65 Matson Hills Rd, South Glastonbury, Conn

MORE DATA? Circle 134, inside back cover

Unipunch mounting accessories for hole punching and notching setups on press brake bed rails include end stops adjustable front-to-back in three positions; adjustable back stops that are combination stops and work supports; Unispacers that snap into the groove and slide along this groove for accurate positioning of Unipunch hole punching and notching units. Each Unispacer has a scribed centerline for convenient gaging.

Punch Products Corp, 370 Babcock St, Buffalo 6, NY

MORE DATA? Circle 135, inside back cover

Insertion and removal tools for use with the Deutsch DS snap-in contact connector line have replaceable tips. The insertion tool inserts and locks the snap-in contact in a positive alignment position, then slips back out of the insert hole free of the contact wire. Removal tool relaxes the contact retention spring and pushes the contact toward the rear of connector for easy removal.

Deutsch Co, Electronic Components Div, Municipal Airport, Banning, Calif

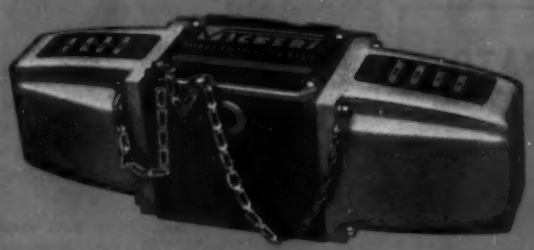
MORE DATA? Circle 136, inside back cover

Improved reliability • Greater capacity • No increase in price

NEW DIRECTIONAL VALVE DESIGNS

WITH VICKERS Q-E-L* SOLENOIDS

- New Q-E-L* solenoids assure quiet, cool operation plus shock-free performance through superior cushioning.
- Four to five times more cycle life than previously obtainable with ordinary air-cooled solenoids.
- Capacity increased from 50 to 500% on new designs.
- All models suitable for pressures to 3000 psi.
- Complete range of sizes available for maximum flows to 440 gpm.



MODEL DG4S4 is rated at 8 gpm (with nominal pressure drop) with a maximum allowable capacity of 12 gpm without malfunction. Maximum recommended operating pressure is 3000 psi. Standard subplates are available with ⅜ in. or ½ in. pipe thread ports. SAE straight thread port connections can also be provided.

MODEL DG5S4 solenoid-controlled, pilot-operated valve is rated at 30 gpm (with nominal pressure drop) with a maximum capacity of 80 gpm without malfunction, depending on circuit conditions and valve type. Standard subplates are available with ¾-in. and 1 in. pipe thread connections. SAE straight thread port connections can also be provided. Write for Catalog 5001-C.

8596

* Q-E-L designates Quiet Extended Life solenoid—a *Vickers exclusive.*

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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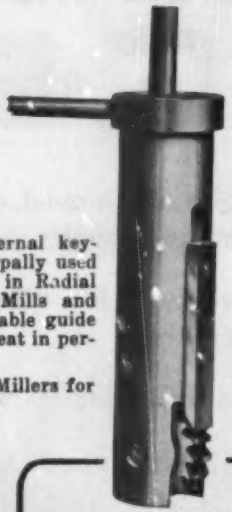
NATIONAL
Keyseating Millers



NATIONAL Keyseating Millers are mechanically simple in construction, sturdily built, designed for milling internal keyseats, faster and better. Although principally used in Drill Presses they can also be used in Radial Drilling Machines, Horizontal Boring Mills and Milling Machines. An exclusive demountable guide on body of Miller assures a straight keyseat in perfect alignment with axis of bore.

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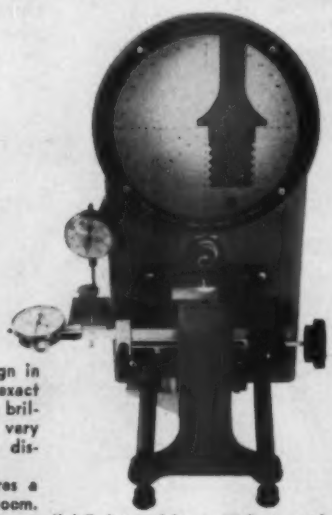
- .005 — .150 radius lines.
- 7¾" dia. screen.
- Reinforced fiber glass moulded case —approx. 20 lbs.



MICRO-VU is an entirely new practical design in an Optical Comparator, it is ruggedly built to exact tolerances and offers a lens system that gives a brilliant and sharp image that is uniform to the very edge of the screen without any measurable distortion.

Its 20-1 Acromatic, color corrected lens insures a bright and clear image even in a well lighted room. The measuring stage has a cast iron table with a parallel T-slot and has a 3" horizontal, 2¾" vertical and ⅜" focusing movement.

An 0-180, 0-180 protractor with Vernier scale, radius lines from .005 to .150 and "straddle" dimension lines are included on the 7¾" diameter screen. 110V AC reduced to 6v. Made 100% in the United States of America.

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NEW SHOP EQUIPMENT

Two manually operated vises—Jawset which is designed for fast production runs and Rapidset which can be adjusted to any position in a matter of seconds—have locking pressure of two tons and better. They can be used for light milling, boring, and general machine shop or production work—*Harig Mfg Corp, 5747 W Howard St, Chicago 48, Ill*

MORE DATA? Circle 137, inside back cover

Model 150 power supply, for arc spot weld gun, has 5 heat stage receptacles and male plugs which insure fast, positive connection. Used with the Model H arc spot gun, the supply will weld 14 gage or lighter to any thickness (minimum 2 pieces 26 gage) — *Bren Weld Corp, 5114 3rd Ave, Brooklyn 20, NY*

MORE DATA? Circle 138, inside back cover

Positive reverse driver for 4 and 5-position turret drilling heads makes it possible to tap directly off any spindle. Its use, however, is restricted to drill presses with reversing motor —*Chicago Quadrill Co, 1846 Busse Hwy, Des Plaines, Ill*

MORE DATA? Circle 139, inside back cover

Tapping head for tool and die makers chucks in drill press in only 10 sec. Half-inch straight round shank fits in drill press chuck; 9/32-in. hole in lower spindle takes Yankee type shank. Priced at $13.95, it's tapping rate is 350 holes an hr—*Babcock Mfg Co, 5632 Shafter Ave, Oakland 18, Calif*

MORE DATA? Circle 140, inside back cover

Transistorized electronic comparator, priced under $250, operates on four pen lite batteries for about 200 hr. Features: range, 0.006 from zero center ±0.003, first setting 0.001 graduation, second setting 0.000,010 —*Taper Micrometer Corp, 100 Grove St, Worcester, Mass*

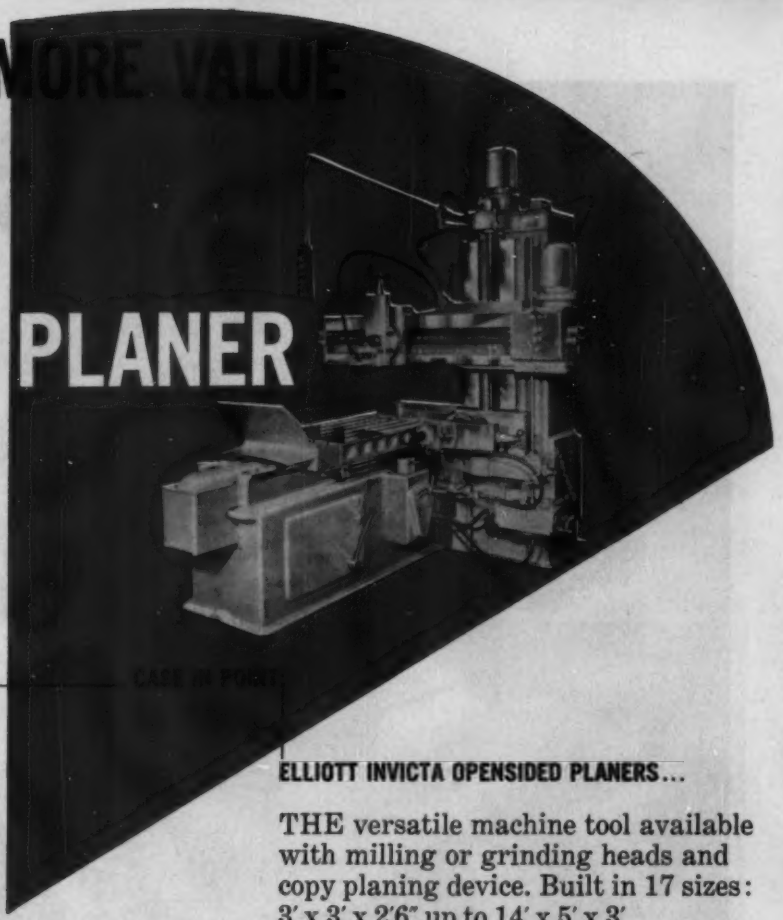
MORE DATA? Circle 141, inside back cover

Portable nibbler that can also be mounted in a vise for bench work is available in six types for making curves, circles, and straight cuts. Models are designed for cutting stainless up to 10 gage; 8-gage mild steel; non-ferrous metals up to 3/16 in.; ¼ in cold or rolled steel; and 5/16 in. aluminum. Units weigh from 8 to 20 lb, depending on the model.

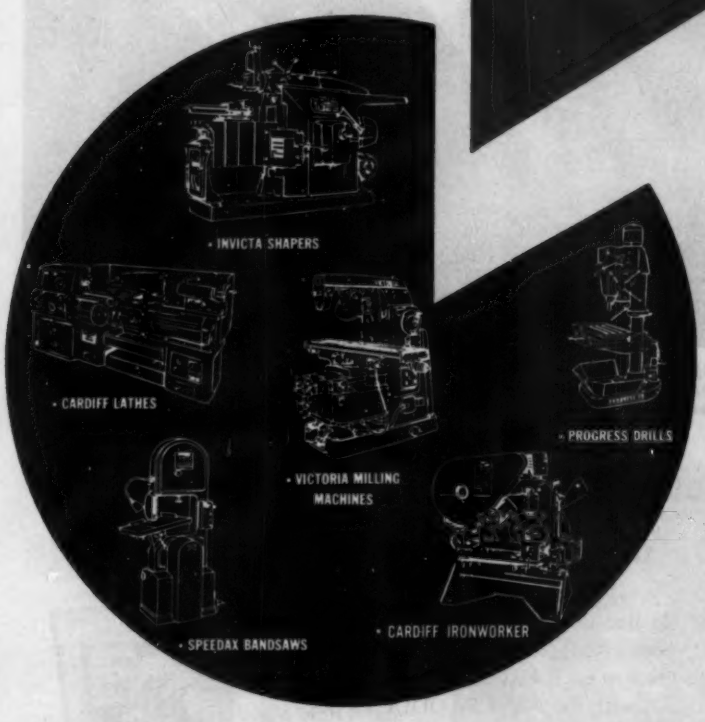
Fenway Machine Co, 3107 N Broad St, Philadelphia 32, Pa

MORE DATA? Circle 142, inside back cover

YOU GET MORE VALUE WITH THE ELLIOTT INVICTA PLANER



The diversification of precision machine tools manufactured by ELLIOTT are designed to fulfill your very specialized needs.



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- hydraulic automatic tool lifts
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- main drive horse power up to 60 h.p.
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DOUBLE HOUSING PLANERS ALSO BUILT FROM 8′ X 4′ X 3′.

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ELLIOTT MACHINE TOOLS MANUFACTURERS

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CIRCLE 406 READER SERVICE CARD

THE NEW M109 Ratiomotor (foreground) for horizontal right angle drives is furnished with 1/20 hp or .035 hp motor. Output speeds range from 43.8 to 350 RPM. New standard mounting bracket shown permits easy mounting in many positions. The NEW MW109 (in hand), for horizontal parallel drives, is also furnished with 1/20 hp or .035 hp motor. Output speeds range from 1.9 to 70 RPM.

NEW Ratiomotors meet demand for

BOSTON Gear efficiency in "pint-size" power packages

Now, you can get BOSTON Gear quality and lasting economy in speed reducers for drives as low as .035 hp. Two new units, designed for space-saving, provide a wide range of output speeds.

When you need worm-geared reducers, you'll find any type and ratio you want in the big line of over 1600 BOSTON Gear 100 Series Reductors and Ratiomotors . . . and you can get it FROM STOCK. Catalog No. 57, with the NEW PRODUCTS Supplement, lists full information. Get your copy. Boston Gear Works, 60 Hayward St., Quincy 71, Mass.

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Ask Distributor for NEW PRODUCTS SUPPLEMENT to Catalog No. 57

CALL YOUR NEARBY BOSTON Gear DISTRIBUTOR

— STANDARDIZATION PAYS —

Cleveland Punch & Shear Bought by Ohio Forge

Cleveland Punch & Shear Works Co, manufacturer of mechanical power presses, fabricating machines for structural steel and steel plate, and punching tools and dies, has been purchased by Ohio Forge & Machine Corp. Cleveland will be operated as a subsidiary of Ohio Forge under its old name and with all present personnel.

Stanley Electric Tools Entering Air Tool Field

Stanley Electric Tools, a division of the Stanley Works, New Britain, Conn is going into the air-driven industrial tool field with the introduction of air routers and a 12 gage air shear. The new tools will be sold directly to industrial users.

Grimes Engineering Acquires LeCount Tool Works

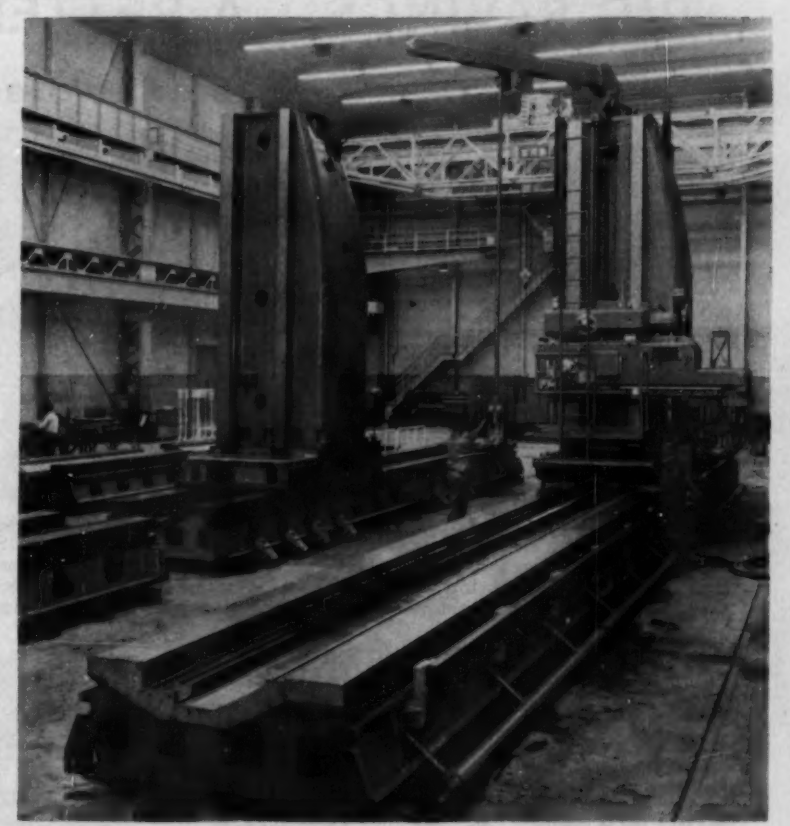
Grimes Engineering Corp, Cheshire, Conn, designer and manufacturer of machine tool accessories, has purchased LeCount Tool Works of West Hartford. LeCount was founded in 1847 and has been producing expanding mandrels and other workholding fixtures since that time. Most of its production operations will be combined with the present Grimes operations until a new plant is constructed to house both.

GM to Make Investment Next Year Of 1¼ Billion

This healthy amount will represent General Motors' world-wide expenditures for plant, machinery, equipment, and tooling in 1961, according to Chairman Frederic G Donner. Mr Donner also reports that GM has spent approximately $1.2 billion in the US and abroad this year to introduce its new models, and for plant, machinery, equipment, and tooling.

Rudel Machinery Co Ltd Merges With Canadian Fairbanks-Morse

Rudel Machinery of Canada, under a merger agreement, will continue its present management and policies as a separate autonomous subsidiary of Canadian Fairbanks-Morse. Only Rudel of Canada is included in the



CWB horizontal boring, drilling, and milling machine has just been completed and a second one is being assembled by Mitsubishi Shipbuilding & Engineering Co of Tokyo under technical agreement with Innocenti S G of Italy. A floor-type FAF 140/95, it'll be used mainly for manufacturing marine diesel engines. Mitsubishi has already received more than ten orders from local machinery makers and a number of inquiries from overseas

National Tool, Die & Precision Machining Association changed its name from **National Tool & Die Manufacturers Association** at its 15th annual convention in Minneapolis and elected its officers for 1960-61. They are, from left to right, **John D Dewhurst**, president, **Arrow Tool Co**, Wethersfield, Conn, named first vice president of the Association; **Fred D Wright**, president, **Fred D Wright Co**, Nashville, Tenn, secretary; **E W Barnwell**, president, **Apex Corp**, Roseville, Mich, second vice president; **Harold G Murdock**, vice president, **Arrowsmith Tool & Die Corp**, Los Angeles, president; **Rolf H Berg**, vice president, **Atols Tool & Mold Corp**, Chicago, treasurer; and **Charles R Bender** executive secretary

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here are more examples of how:

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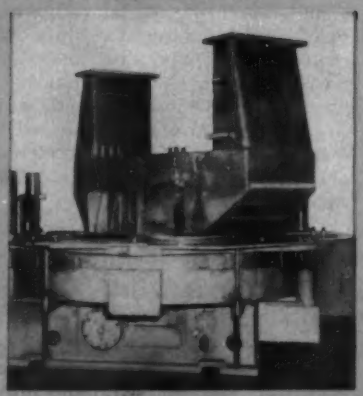
FLATNESS OF .0000116" or less with a micro-inch finish of 2 to 3 RMS is everyday work for a Lapmaster. Uniform accuracy maintained piece-after-piece because conditioning rings automatically keep lap plate flat.



4920 LB. PARTS can be handled—as well as small ¼" dia. pieces. This 84" dia. weldment for a radar tracking antenna was lapped to a flatness and parallelity within ± .00005" on a Lapmaster Model 84.

TALL and SMALL PARTS AT THE SAME TIME. No expensive fixturing required... in most Lapmaster applications only inexpensive masonite or micarta work holders are necessary. Eliminates danger of stresses and warpage usually caused by clamping during grinding.

EXTERNAL and INTERNAL LAPPING IN ONE OPERATION. Versatility of the Lapmaster is demonstrated in this lapping operation on R. R. air brake parts. Reciprocating mechanism runs small lapping block in and out of work while other parts are being lapped on plate.

SHAPE OR FORM NO PROBLEM. Special lap plate and work holder permit lapping of swing check valve. Other simple attachments and holding devices can be furnished to facilitate lapping of "hard-to-handle" or extremely large parts.

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...THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

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In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

merger; Rudel Machinery Co of New York, one of the largest machine tool distributors in the US, is not affected.

The largest machine tool distributorship in Canada results from the combination of these two leading distributors.

Falcon to Fly From Atlanta

Beginning Dec 12, Ford Motor Co will produce the Falcon at its Atlanta assembly plant. Approximately 200 of the compacts will be turned out daily. Production of standard size Fords in all models will continue at the plant which is temporarily shut down for a month-long make-ready period for the Falcon addition.

Birdsboro to Build First Shear To Cut Spent Nuclear Elements

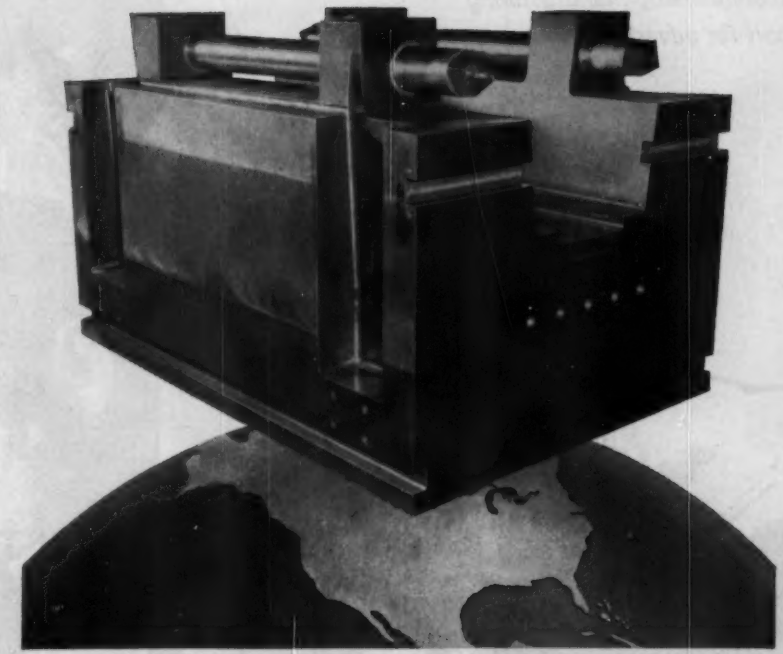
Birdsboro Corp, Birdsboro, Pa, has a contract to design and build the country's first shear for cutting up spent nuclear fuel elements. Shear will represent the initial processing step in reclaiming spent uranium. It'll be engineered under a contract let by Union Carbide Nuclear Co of Union Carbide Corp, Oak Ridge, Tenn.

Machine, which will be operated by remote control in a concrete, radiation-proof cell, is described as a horizontal stroke type of shear which will be run by a 100-gpm hydraulic power unit. It'll cut fuel elements in all sizes ranging from 3½ to 9 in. square by 48 to 72 in. long. Discharged pieces will be conveyed to an acid dissolver for reprocessing.

Crane Buys British Pump Firm

Crane Ltd, London, England, subsidiary of Crane Co, Chicago, has purchased Rhodes, Brydon & Youatt Ltd, 110-year-old manufacturer of an extensive line of centrifugal pumps. Manufacturing facilities are located at Stockport, Cheshire.

"We all laughed at Smife when he used the big hydraulic press to do his trousers. But when we saw the results he got . . ."



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A metalworking manufacturing report for advertisers

Design huddle produces ideas for machine which "flows" a metal ring into a seamless compressor case. Standing, l. to r.—L. J. Dolin, superintendent, experimental sheet metal; Robert Knowlton,

Lighter, stronger, faster jet engines... constant challenge for

Pratt & Whitney Aircraft's manufacturing miracle men

Management team pioneers major breakthrough in metalworking manufacturing

Check-up—Bob Knowlton (l.), Stan Rusczik (r.) and operator Dominick Cassanta double check thickness of casing made on one of P&W's smaller flow turn machines.

New horizons—Production Engineer Edward Griswold, Bob Knowlton, Stan Rusczik and Lou Dolin confer on assembly of new machine capable of flow turning an 80" cylinder.

supervisor, advanced tool engineering; Stanley Rusczik, production engineer; and Robert C. Wright, chief, production engineering, for P & W—and, front, Claus L. Sporck, V.P., Lodge & Shipley Co.

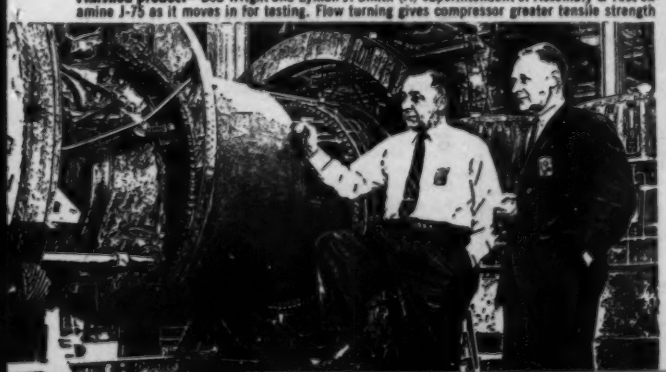
The difference between a 2-oz. jigger and a combustion chamber case for a 25,000-pound-thrust class J-75 jet engine is years of planning, imagination, engineering—and purest optimism. But it's typical of the manufacturing miracles that Pratt & Whitney Aircraft brings off as a matter of course.

The power plants for jet transports which now fly the Atlantic in 6½ hours are lighter, faster and stronger because a Norwegian engineer placed a 2-oz. jigger on the desk of the chief of advanced tool engineering at P&WA. The piece was unusual: seamless, even-walled, lightweight, finely-finished, and made on a machine that literally "flowed" a metal ring into cylindrical or conical shapes.

Here was an idea—if only it could be done on a large-enough scale. P&WA manufacturing men decided to give it a try. They teamed up with machine tool manufacturers Lodge & Shipley to produce the first flow turning machines in the U.S.—and the giants that are now turning out compressor cases and other highly stressed parts for P&WA jet engines.

The story of flow turning (*or shear forming as it is sometimes called*) has been told in detail in American Machinist/Metalworking Manufacturing. It's a story of the constant search for better ways to make things of metal. Our job is to keep manufacturing management men in metalworking posted on developments that will help solve manufacturing problems. More than 41,000 of them turn to AM/MM for just that kind of help. Here, then, is the ideal place to show how *your* product can help them!

Finished product—Bob Wright and Lyman J. Smith (r.) superintendent of Assembly & Test examine J-75 as it moves in for testing. Flow turning gives compressor greater tensile strength



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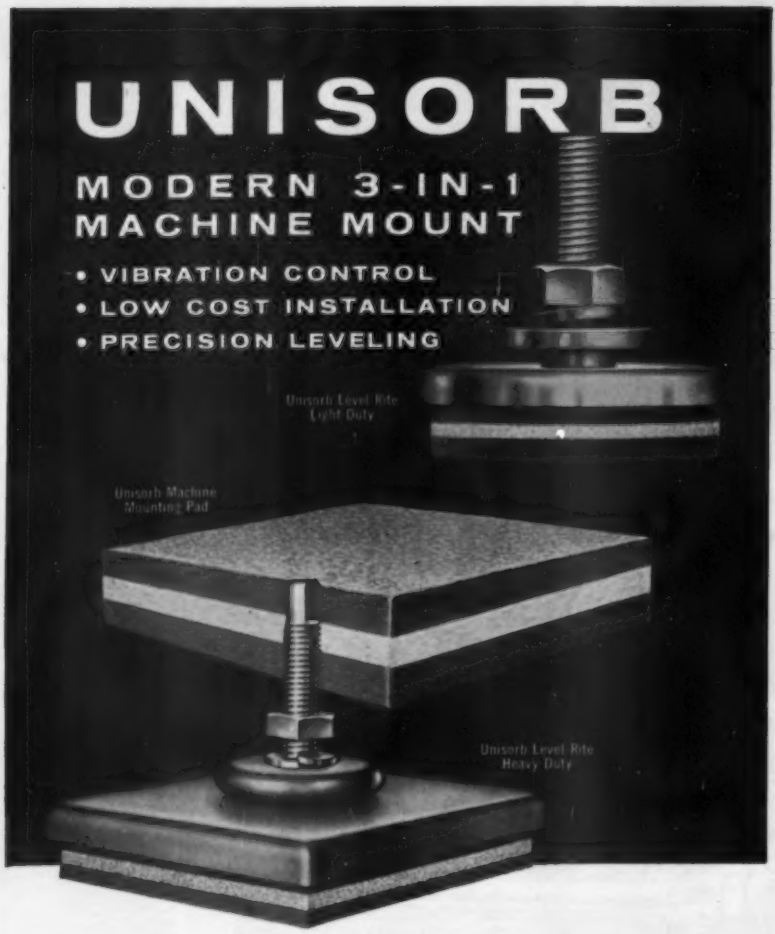

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MACHINES AND ATTACHMENTS

1 CONVERTIBLE BROACHING MACHINES—*Sundstrand Machine Tool, Belvidere, Ill.* 12-page bulletin (Form No. CB-1) illustrates and describes features of Sundstrand-American 4-way broaching machines in 5 to 50-ton capacity, 30- to 90-in. strokes. Basic vertical design can be arranged for or converted to these operations: push down; surface; pull down; pull up. Includes dimension tables and drawings, specifications, accessories.

2 CHUCKING MACHINES — *Baird Machine Co, 1700 Stratford Ave, Stratford, Conn.* 8-page catalog 10, Rotary Automation, discusses the capabilities of high speed automatic 6 and 8-spindle chucking machines. Tooling possibilities, engineering, and construction of the Model 76-H and Model 78-H chuckers are described as well as secondary machining attachments which increase versatility, speed production, and cut manufacturing costs.

3 TAPE-CONTROLLED MANUFACTURING CENTER — *Kearney & Trecker Corp, 6800 W National Ave, Milwaukee 14, Wis.* 4-page brochure MM3 illustrates and describes the Milwaukee-Matic Model III with approximately twice the working capacity of Model II. Unit, with automatic tool changer, offers flexible automation to do an entire job automatically on this single, integrated, numerically controlled machine which unifies face milling, end milling, drilling, reaming, tapping, boring, counterboring, countersinking, and spotfacing. Spindle speeds (three ranges) are 50 to 2000 rpm in 10-rpm increments. Feed rates for all axes range from ½ to 49 ipm in ½-in. increments. Rapid traverse rate is 150 ipm.

4 SURFACE GRINDERS AND LAPPING MACHINES — *Taft-Peirce Manufacturing Co, Woonsocket, RI.* 16-page catalog 318 explains the important features that have been added to the No. 1 precision surface grinder, the 6-in. rotary grinder, the 24-in. semi-automatic lapping machine, the 24-in. rotary lapping machine, and the back spotfacing machine. Accessories and attachments described.

5 AUTOMATIC FORM GRINDERS—*Jones & Lamson Machine Co, 160 Clinton St, Springfield, Vt.* 6-page bulletin covers latest models. Both of these machines feature perpetual form control for wheel trueing. Model E-2 uses the standard J&L trueing devices with PFC. Model E-3 has a new type of vertical trueing device which offers a full 12 in. of wheel spread with perpetual form control.

6 SHEAR-SPEED SHAPERS—*Michigan Tool Co, 7171 E McNichols Rd, Detroit 12, Mich.* Bulletin 3000-60 pictures and describes new Series 3000 for rapid cutting of gears and other external forms. Methods of obtaining faster chip disposal and providing through-feed automation are illustrated. Model 3053 cuts parts 1 to 5 in. dia and Model 3073 cuts parts 3 to 7 in. in dia.

7 SHAPE-RITE SHAPER — *Havir Manufacturing Co, 444 N Cleveland, St Paul 4, Minn.* 4-page bulletin provides information on Hy-Duty Models with 8-in. stroke. Features described and specifications listed.

8 DIAMOND TOOL LATHE — *Milo Manufacturing Co, 259 N Broad St, Elizabeth, NJ.* Technical bulletin on Bryant Symons precision unit includes chapters on surface finish and outlines the various methods of measuring surface finish; includes a chart showing surface roughness

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

available by common production methods; describes what a diamond tool lathe is and lists applications; gives specifications for five standard models available.

9 COLD HEADING MACHINES — *REM Sales Inc, West Hartford, Conn.* 4-page bulletin gives data on Morris-Omega precision units for small and miniature parts and long, thin, pins and rivets. Diagrams illustrate method of making hollow rivets with these machines.

10 TAPPING OF SUPER-STRENGTH ALLOYS—*National Twist Drill & Tool Co, Rochester, Mich.* 8-page booklet illustrated with diagrams and charts discusses cutting characteristics of three classes of super-strength alloys: high temperature alloys; high hardness high strength steels; and high strength titanium alloys. Tapping technique is described; tapping speeds; cutting fluids; and leadscrew tap control are covered.

11 FEED UNITS—*Buhr Machine Tool Co, Ann Arbor, Mich.* 4-page brochure details a new concept in hydraulic way type feed units available in four sizes, two platen styles, to meet every job requirement. They can be equipped with Buhr's integral motor bracket type platen or the standard flat platen. All dimensions are to the industry's special machine tool standards. Complete specifications listed.

12 TRUFORM DRESSER—*Landis Tool Co, Waynesboro, Pa.* 4-page bulletin TD-60 pictures and gives details on the new Landis Trueform shake-free dresser that makes it possible to dress a grinding wheel to exactly the same shape as the profile bar without the necessity of honing or modifying the profile bar in any way to compensate for clearances found in sliding members of conventional dressing devices.

13 TANGENT BENDING MACHINES *Taylor-Winfield Corp, 1048 Mahaning Ave, Warren Ohio.* 12-page bulletin 13-093A describes line of air-operated units. Specific information correlates bending radius with flange height that can be smoothly contained in compression or tension positions during tangent bending of sheet steel. Standard designs of machines are single wing, duplex and quadruplex. Open-side and multiple-die designs increase production rates obtainable.

(Continued on p 230)

"He has quite an impressive folder — three space flights and a couple of generals as references!"

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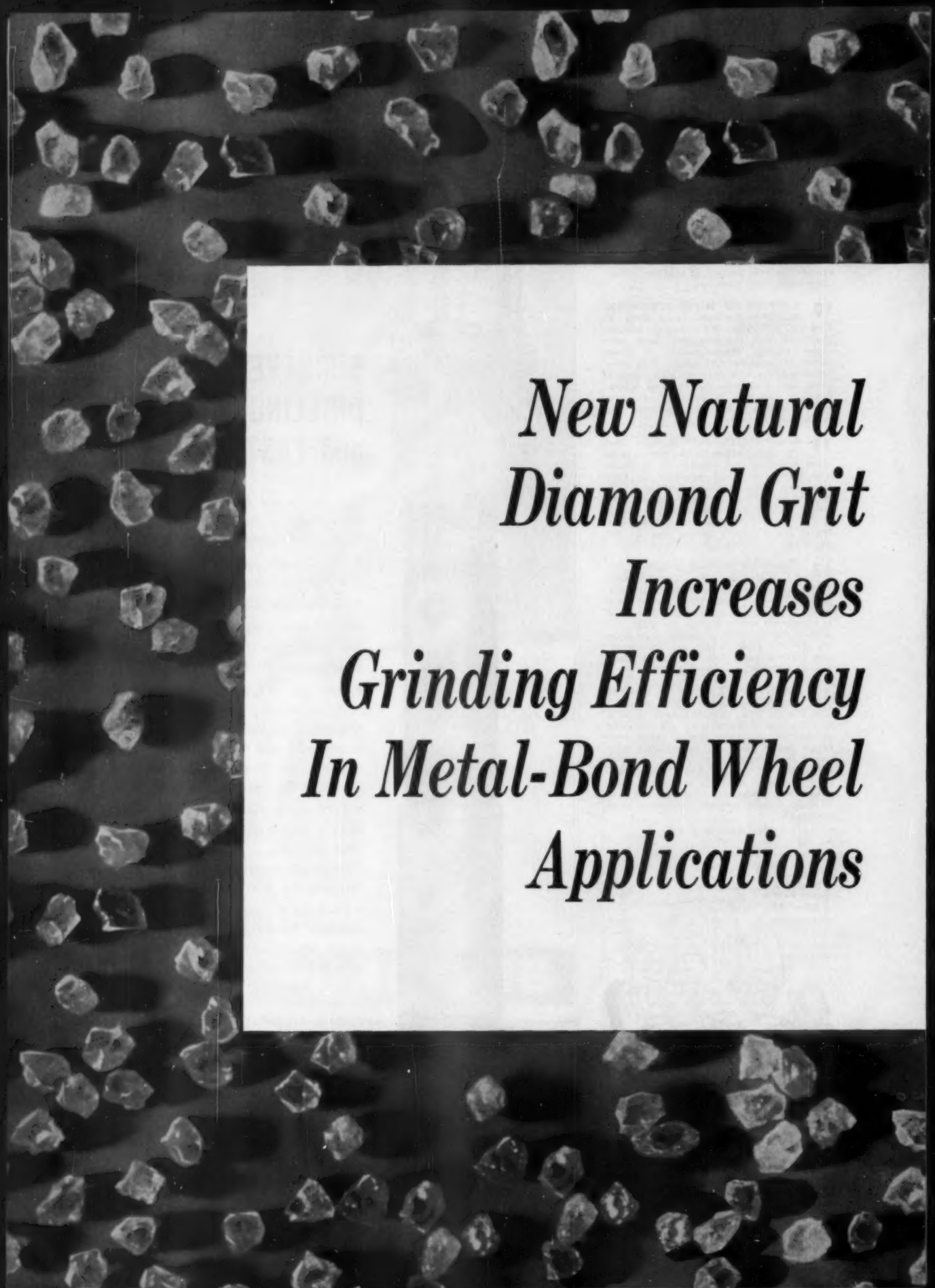
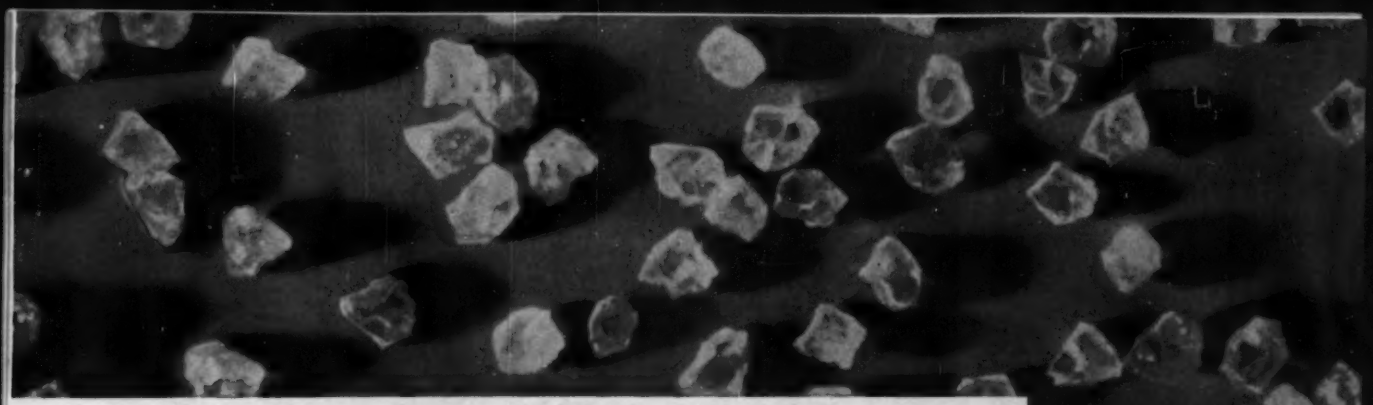


New Natural Diamond Grit Increases Grinding Efficiency In Metal-Bond Wheel Applications



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A unique shape selection and pressure process has made this new natural grit possible. Only particles of predominantly blocky shape are selected, since research and field applications have shown that in metal-bond wheels blocky shapes are stronger and more resistant to abrasion. The result of this new process is a natural diamond grit which can be retained longer in the bond, thereby increasing grinding efficiency in metal bond-wheel applications.

SND-MB (Blocky) is available in mesh sizes ranging from 16/20 to 325/400. Larger sizes are used in heavy-duty applications such as concrete and stone cutting. Smaller sizes are used in metal-bond wheels for grinding and cutting such materials as glass, ceramics, and reinforced plastics.

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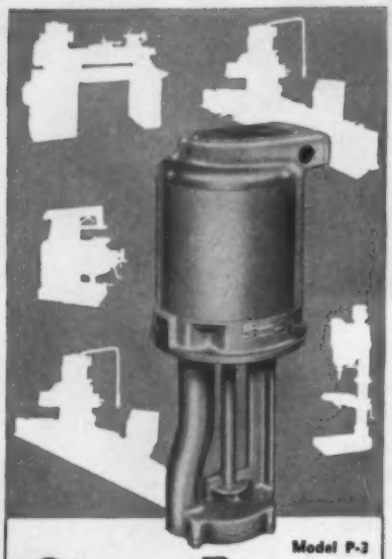

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TOOLS AND ACCESSORIES

14 GRANITE SURFACE PLATES — *Rahn Granite Surface Plate Co, 641 N Western Ave, Dayton 7, Ohio.* 20-page brochure contains 55 technical answers to questions about granite surface plates. Information which ranges alphabetically from accuracy to waviness, covers such topics as calibration; cause of errors in surface plate; hardness vs density; job grade; repeat measurements; resurfacing; stiffness; temperature; warping.

15 MARKING EQUIPMENT — *Noble & Westbrook Manufacturing Co, East Hartford 8, Conn.* 37-page catalog 60 covers complete line of equipment for permanent indented marking. Basic marking machines and related accessories illustrated and described. Catalog is sectionalized for quick reference on roll marking, press stamping, hand stamping, graduating, marking dies, and tools.

16 MACHINING AND GRINDING CONCENTRATE — *Baker/Gubbins Co, 1442 Wabash Ave, Detroit 16, Mich.* Data sheet describes concentrate No. 217-B, recommended as a fortifying agent for cutting, grinding, tapping, and drawing oils. Diversified extreme pressure agents in this concentrate are reported to increase both feeds and speeds as much as 30% while simultaneously improving tool life and producing better parts finish of ferrous alloys.

17 BUFFING AND POLISHING SPEED CALCULATOR — *Hanson-Van Winkle-Munning Co, Church St, Matawan, NJ.* 3 x 5-in. disc calculator for determining the surface speed of both buffing and polishing wheels provides instructions on how to find the surface speed in feet per minute of any wheel from 1 to 60 in. in diameter turning at spindle speeds from 220 to 20,000 rpm.

18 HARDNESS TESTING EQUIPMENT—*Wilson Mechanical Instrument Division, American Chain & Cable Co, 230 Park Ave, New York 17, NY.* 24-page catalog RT-60 contains information on the principle of the Rockwell hardness test and of microhardness testing. Illustrates and describes Rockwell and Superficial hardness testers and Tukon microhardness testers. Also covers several models designed for specific uses; fully automatic models; the new Wilson mobile tester; diamond Brale penetrators; and variety of Rockwell accessories.

19 END MILL CHART—*Chicago-Latrobe, 411 W Ontario St, Chicago 10, Ill.* 8½ x 11 in. chart, printed on cardboard, lists suggested speeds, feeds, and styles for high speed end mills.

HEAT TREATING AND WELDING

20 NITRIDING PROCESSES—*Armour Industrial Chemical Co, 110 N Wacker Drive, Chicago 6, Ill.* 14-page illustrated technical bulletin TM-1 covers the case hardening of metals with anhydrous ammonia atmospheres in various nitriding applications. Includes a brief history of nitriding and information on equipment and techniques. Presents technical data in tabular and chart form.

21 SINTERING—*Electric Furnace Co, 600 W Wilson St, Salem, Ohio.* 16-page bulletin 603 describes advantages, physical properties, and applications of powdered metal parts; discusses design principles and illustrates the different types of furnaces that are being used to heat treat the compacts.

● HEAT TREATMENT OF CAST HARDENABLE STAINLESS STEELS—*WaiMet Alloys Co, Division of Howe Sound Co, 5330 Oakman Blvd, Dearborn, Mich.* 24-page technical research report on heat treatment and properties discusses in detail the heat treating variables of hardenable stainless steels that have chemistries suitable for investment casting. Alloys included in the report are Type 410 straight martensitic stainless; 17-4PH precipitation hardenable martensitic stainless; and AM-355 semi-austenitic precipitation hardenable stainless. Results obtained from recent studies, concentrating on the conditions and problems peculiar to investment castings, and regarding transformation behavior and the effects of chemistry of these alloys are discussed in detail. Request direct on company letterhead.

PARTS AND MATERIALS

22 HIGH TEMPERATURE ALLOYS—*Haynes Stellite Co, Division of Union Carbide Corp, 270 Park Ave, New York 17, NY.* 20-page booklet covers comparative properties of company's complete line. Seventeen leading alloys are compared against each other in the areas of physical, mechanical and chemical properties, and stress-rupture data. Charts show selected properties for each alloy at specific temperatures. Data covers the alloys in various forms such as sheet, bar, sandwich, and investment castings.

23 SPHERICAL METAL AND ALLOY POWDERS — *Linde Co, 270 Park Ave, New York 17, NY.* 8-page technical bulletin, Form 1402, describes a new process for producing spherical powders of metals and metal alloys in sizes ranging from 5 to 150 microns. Spherical powders currently in stock include copper, aluminum, nickel, type 316 stainless, tungsten, and Nichrome V. Physical data on these powders, which contain fewer than 2% nonspherical particles, is outlined along with material on suggested applications.

24 BELTING—*Boston Woven Hose & Rubber Division, American Biltrite Rubber Co, PO Box 1071, Boston 3, Mass.* 36-page catalog gives complete specifications and information on full line of conveyor, elevator, and transmission belting. Includes tabular data on belt weights, gages, fabrics, and recommendations.

"I always thought situations like this happened only in cartoons!"

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Mechanical Tool Changing Controlled Completely by TAPE COMMAND

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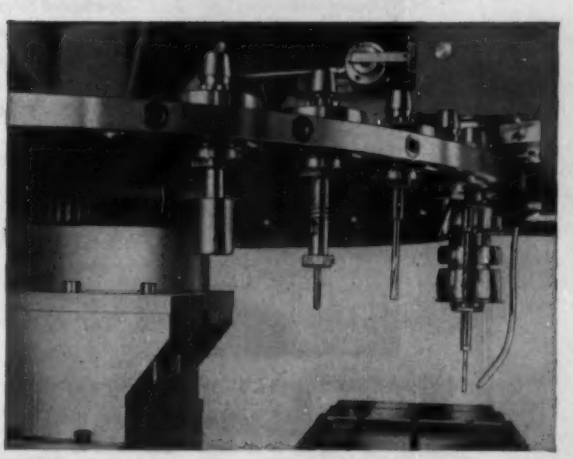

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1012

NAMES IN THE NEWS

Allis-Chalmers Manufacturing Co, Milwaukee, has appointed **C L Brisley** and **L M Dings Jr** chief industrial engineer and chief production engineer, respectively, West Allis Works. Mr Brisley was formerly associated with A T Kearney & Co, Chicago management consultant. Mr Dings has been serving as group head of architectural liaison for the C Stellarator facility at the James Forrestal Research Center, Princeton, NJ, where work is underway on controlled fusion under AEC's Project Sherwood.

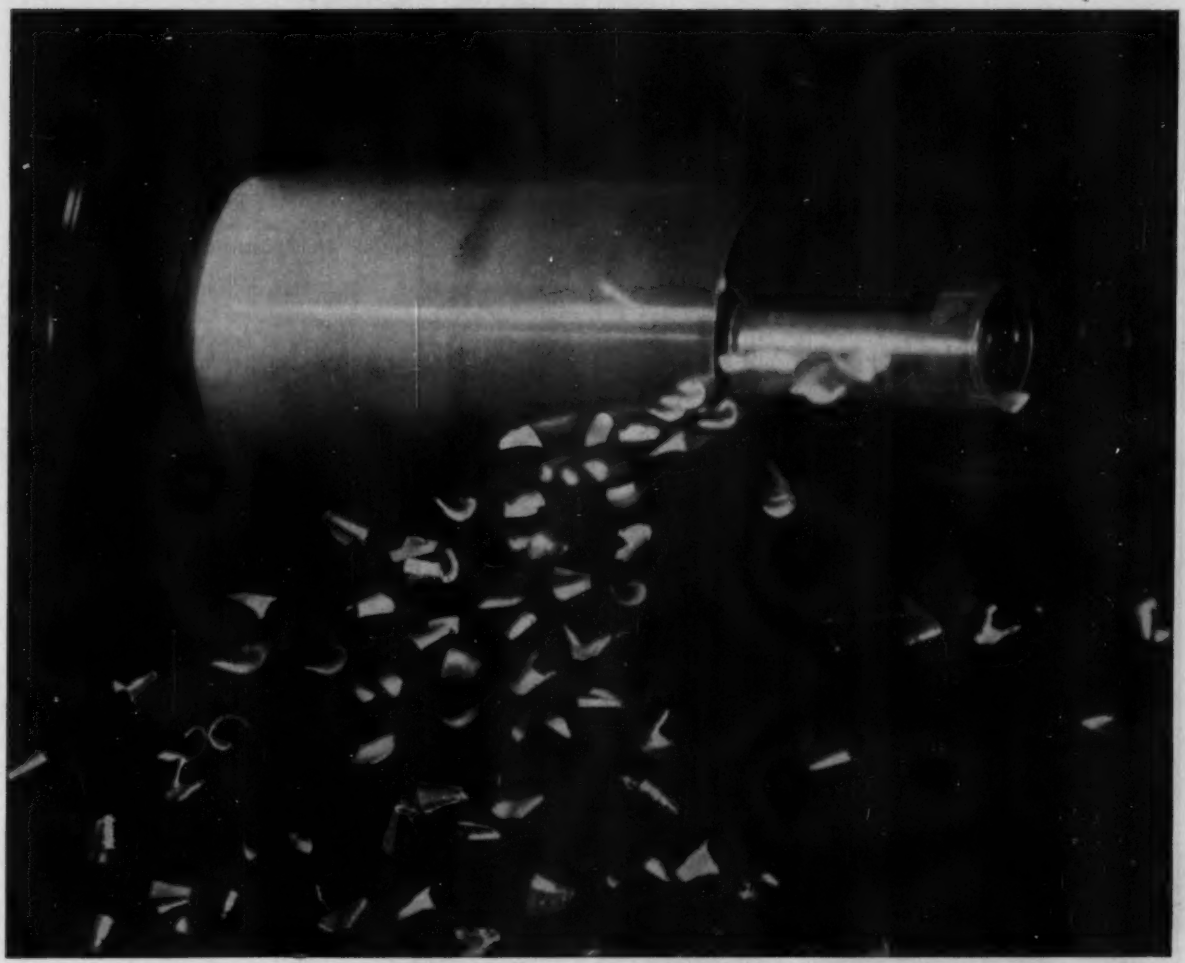
Wilkerson Corp, Englewood, Colo, manufacturer of compressed air filters, regulators, and lubricators, has named **G Keith Bogert** manager of manufacturing. Mr Bogert has joined the firm after serving for the past two and a half years as superintendent of fabrication and processing at Ramo-Wooldridge Division.

Gray Iron Founders' Society has elected **John E McIntyre** president. Mr McIntyre is vice president and general manager of **Sibley Machine & Foundry Corp,** South Bend, Ind. **Cecil Garland,** secretary and comptroller of **W O Larson Foundry Co,** Grafton, Ohio, has been named vice president of the Society.

Ford Motor Co has appointed **Peter H Ponta** director of a newly created organizational unit known as the manufacturing engineering and development office. Mr Ponta was formerly director of the manufacturing engineering office. **William W Aulepp** has been named assistant director, manufacturing engineering, and **Harold N Bogart** assistant director, manufacturing development, both men reporting to Mr Ponta.

Timken Roller Bearing Co, Canton, Ohio, has promoted **E S Hoopes Jr** from the post of general superintendent of the Steel & Tube Division to general manager of Steel & Tube operations. **H R McLaren,** formerly assistant general superintendent, has been named general superintendent, Steel and Tube plants; and **R T Shipley,** previously assistant superintendent of the Steel plant, has been promoted to superintendent of the Canton Steel & Tube plant.

American Vacuum Society has elected **Benjamin B Dayton** president. Mr Dayton is technical director of **Consolidated Vacuum Corp,** a subsidiary of Bell & Howell/CEC.



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Ask your Alcoa distributor . . . or call your nearest Alcoa sales office . . . for the comprehensive *Alcoa Screw Machine Stock Estimating and Operating Data Book.* This reference book puts *all* the aluminum machining data right at your finger tips to make the toughest screw machining job a cinch! Ask, too, for a free *Alcoa Conversion Calculator.* This handy slide rule quickly computes costs, shows percentage savings in making a switch from brass to aluminum.

"PLUS" bonuses — when you use Alcoa Aluminum Screw Machine Stock!

1. Wide range of stock sizes.
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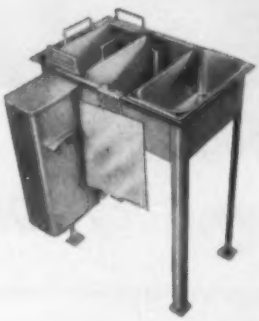

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NEW BOOKS...

ROBERTSON GUIDE TO WORLD SCREW THREAD STANDARDS — *Published by W H A Robertson & Co, Ltd, Lynton Works, Bedford, England. 41 pages, 6 x 9-in. Price $1.50 postpaid.*

P C Harrop, sales manager of this firm, aptly says, "The engineering world is so bedevilled by the multiplicity of screw threads that we decided to collate in one volume the screw thread standards of the world, and give them a common denominator for comparison.

"Over 2000 standards are listed covering the 33 countries which have National Standards for screw threads. No less than 108 screw thread forms are illustrated, together with self-tapping screws."

Let's see how Robertson has done these things. First, reference numbers of standards are usually preceded by letters that identify the country of origin. Suppose you are given a drawing that calls for a "R ½ DIN 259" thread. According to a listing of reference letters against standards by country of origin, you will find that "DIN" represent National Standards of Germany.

Second, from a listing of German standards, we find that No. 259 is equivalent to British Standard parallel, or simply the British Whitworth thread.

Third, if we don't know what the Whitworth thread looks like and the formulas for thread elements in terms of pitch, we look up that thread form, according to the number designated.

In other words, the listing of a given country's national standards has three columns of entries: (1) the number of the standard, (2) the equivalent series in an English, a metric or an American or Unified thread system, and (3) the number of the thread form illustration.

Sizes of threads are not given in detail, but referring to our example "R ½ DIN 259" means that an equivalent thread is a ½ in. Whitworth.

Similarly a Rumanian specification "F 5 9/16 in. x 3.175 con 6.25% STAS 217-53" turns out to be "5.563 OD x 8 tpi API drill pipe thread," or American Peteroleum Institute round-form taper thread.

With the expansion of exports, the problem of supplying fasteners to various national standards becomes bewildering unless there is some way to find out an equivalent thread form and the true size designation

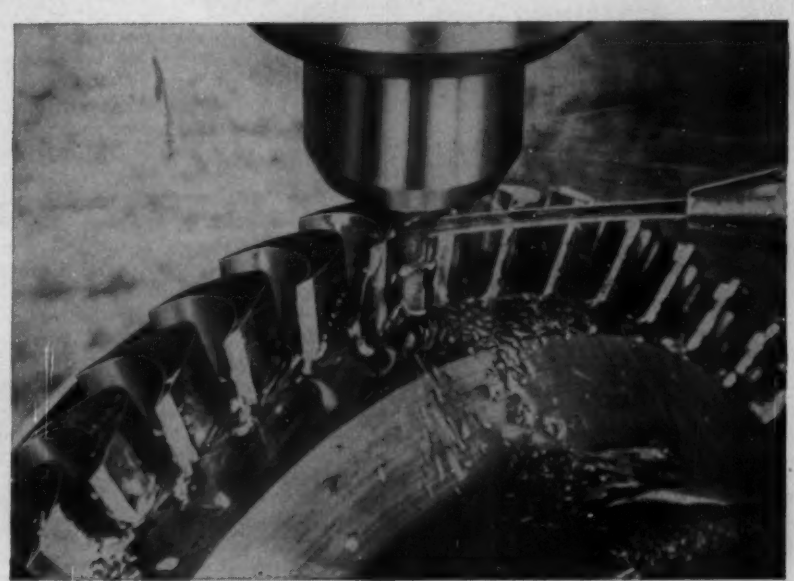
Atrax

Precision Ground
SOLID CARBIDE
TOOLS AND BURS

Job Applications

Solid carbide, 6 flute, ball nose, right hand spiral end mill .170" in diameter easily cuts rugged stainless steel alloy impeller buckets to close, uniform tolerances.

EXOTIC MATERIALS PROVE EFFICIENCY OF ATRAX SOLID CARBIDE END MILLS...



This Atrax end mill was produced as a special only to satisfy exacting tolerances on this extremely tough stainless steel alloy.

PRODUCTION UNIFORMITY

Milling cut was ½" deep. Work piece was held and rotated by means of a cam controlled fixture, the spindle and end mill were stationary. 42 buckets per impeller wheel had to be uniform in size, shape, weight and balance.

LONG TOOL LIFE ESSENTIAL

Because of the close tolerances required, end mills could not be resharpened so that maximum production without changing tool cutting characteristics was vital. Atrax end mills out-produced all others.

SIMILAR SUCCESS MILLING TITANIUM BUCKETS WITH 1/16" DIAMETER ATRAX END MILL!

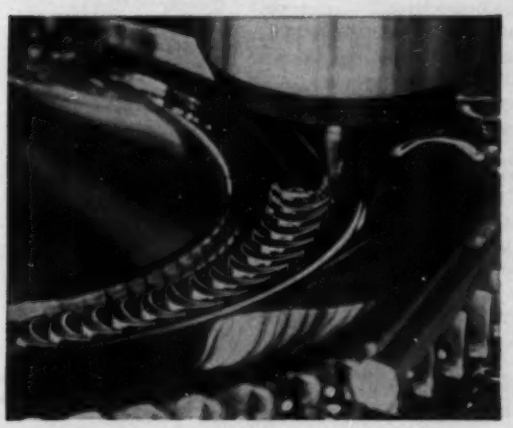


Photo shows a 1/16" diameter Atrax End Mill profiling to fine micro-finish buckets of a titanium turbine impeller. Each Atrax tool completed 72 buckets on each of 4 impeller wheels before replacement. The production performance proved far superior to high speed steel that deflected and broke under initial cut and competitive solid carbide end mill that produced profiling cuts on only 36 buckets before failure.

There's an Atrax Solid Carbide End Mill job engineered for virtually every end milling material and application.

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NEW BOOKS . . .

in understandable terms. This book may not cover every thread system in existence but it does such a thorough job that it will be worth its weight in gold to many users.

UBER WEGGEBER FUR AUTOMATISCH GESTEURTE ARIBEITSMASCHINEN (CONTROLS FOR AUTOMATICALLY CONTROLLED MACHINE TOOLS). *By Opitz, Uhrmeister, Justel, & Burklin. Published by Westdeutscher Verlag, 3 Ophovener Strasse, Opladen/Rhld, Germany, for the University of Aachen. German language, paper bound, 93 p, 8¼ x 11½. Price DM 27.70.*

Fully automatic machining requires automatic positioning of the workpiece, guiding the tool by a templet, line, magnetized strip, or punched card. For unvarying accuracy, a gaging instrument must be guided along the work and must send signals to the tool-guiding system to correct for tool wear before the limits of tolerance have been reached. The guiding and gaging actions may be continuous, or subdivided into a large number of individual actions (digital or numerical system).

Automatic positioning of the work is not discussed. Likewise, the mechanical equipment by which the measurements are converted into tool action is neither discussed nor illustrated. The book is concerned with methods of measuring, and of transmitting the measurements to the electrical part of the tool-guiding equipment. Depending on the type of programming equipment, measurements may be taken by contacting feelers, electric brushes, magneto-electric head, or photoelectric cells. Contact gages, magneto-electric heads, and photoelectric guiding are described and illustrated by diagrams. Measurements are said to be accurate within 1/8000 in. Most of the illustrations are diagrams of electric circuits, including amplifiers, bridges, rectifiers, and switches. Some of the equipment is denoted by the names of German manufacturers, and much space is given to the Eltas gage.

The development discussed in the report follows the same general lines that have been followed in the US since about 1945. Many of the Anglo-American terms indicate the similarity, such as: start, stop, trend, trigger, and flip-flop.

A number of tests were made in the University of Aachen laboratories as to the effectiveness of the various path-prescribing and gaging methods. The report is an interesting recital of the research work done in Germany on automatic machining to close tolerances, and is one of a series of reports on machine-tool research at Aachen. W TRINKS

HIGH PRODUCTIVITY IN HEAVY ENGINEERING — *by A G Thompson. Published by Iliffe & Sons Ltd, Dorset House, Stamford St, London SE 1, England. 339 pages including 36 plates. 5½ by 8¾ in. Price 66.3d ($9.28).*

A practical approach to job-shop manufacture, especially welded fabrication, this book discusses all aspects of heavy metalworking from plant layout and part dimensioning, through equipment selection and the shop processes, to quality control, costing methods, and productivity improvement.

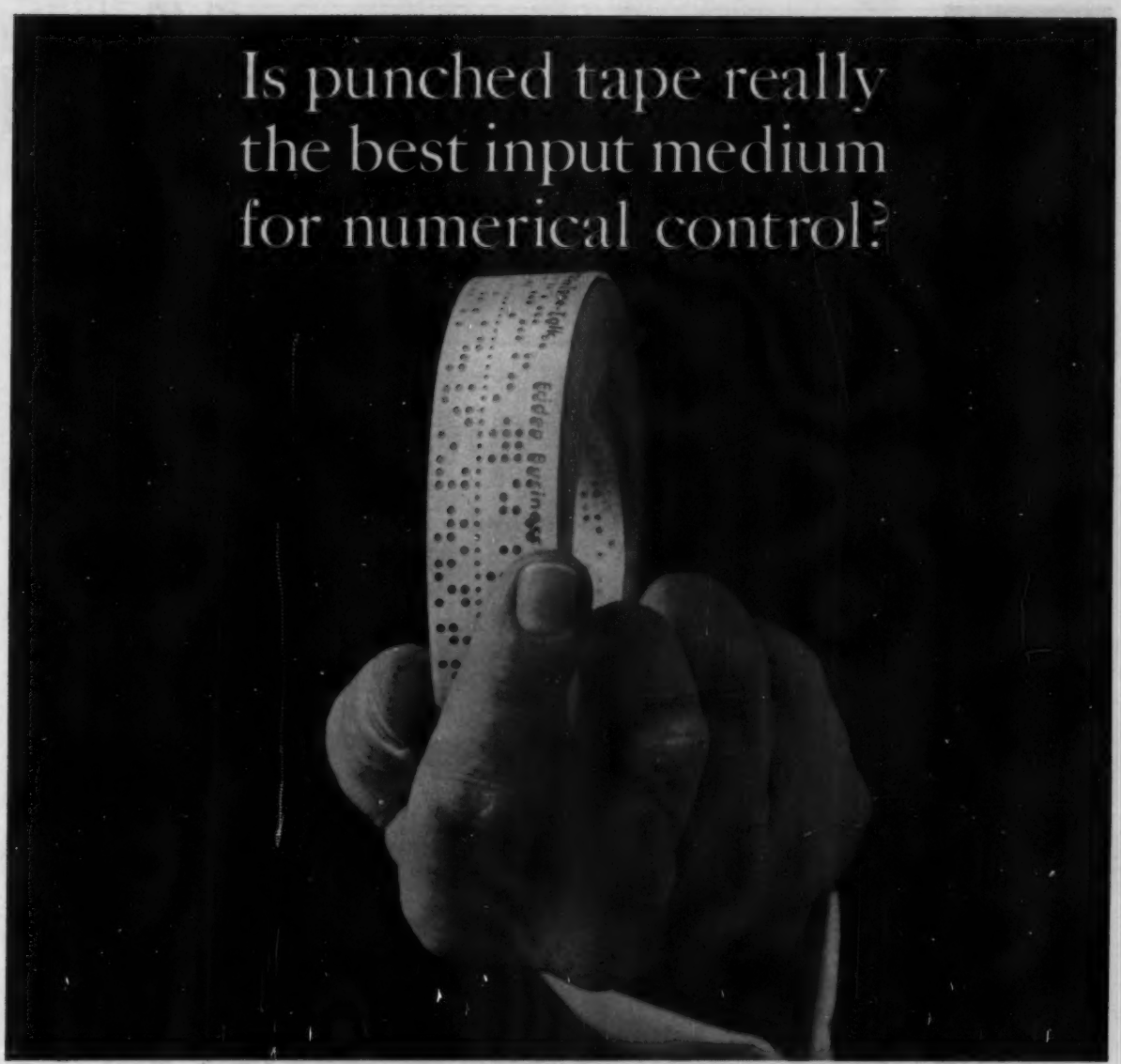
The whole field is covered, but the author has not given exhaustive treatment to the processes that are already fairly well known and that have been dealt with thoroughly in other books. Rather, the book is a review of the basic information with detailed discussions reserved for new developments. Suggestions for further reading are listed at the end of each chapter.

In the chapter on welding processes, for example, there's an average of two pages on each of the popular processes, covering its basic features, operation, and applications, along with a sketch of the process. Seven pages, however, are given over to the new electro-slag process.

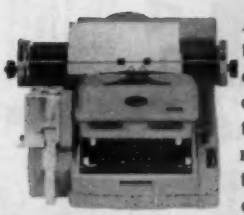
The chapter on metalworking processes deals with basic cutoff and forming equipment for sheet and plate: the various machines available, how they work, and what are the particular advantages of each type. Tape-controlled techniques for oxygen cutting are explained in detail—RTB.

"You've solved your loose hair problem rather neatly, Miss Chedwith."

Is punched tape really the best input medium for numerical control?



(3 out of 4 machine tool makers say yes!)



Although 8-channel punched paper tape is only one of several numerical control input media, it is fast becoming the standard. Better than three-quarters of all builders of numerically-controlled machine tools now offer punched paper tape control. Why the swing to punched paper tape? There are three fundamental reasons:

1) Paper tape coding is visible, tangible. You can see it, touch it, and with practice even read it.
2) Paper tape is continuous. Unlike cards, it can't get out of order.
3) Paper tape is easy to program—preparation, verification, and reproduction of tapes are all handled on one inexpensive machine, the Friden Flexowriter® (illustrated).

For the machine tool buyer, standardization on paper tape means great savings. It's so much easier (and less expensive) when *one* input system can control *all* of the numerically-controlled machines in a given plant.

If you're thinking numerical control, you'll be way ahead to think *punched paper tape.*

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- Greater visability
- More rigidity in cylinder construction
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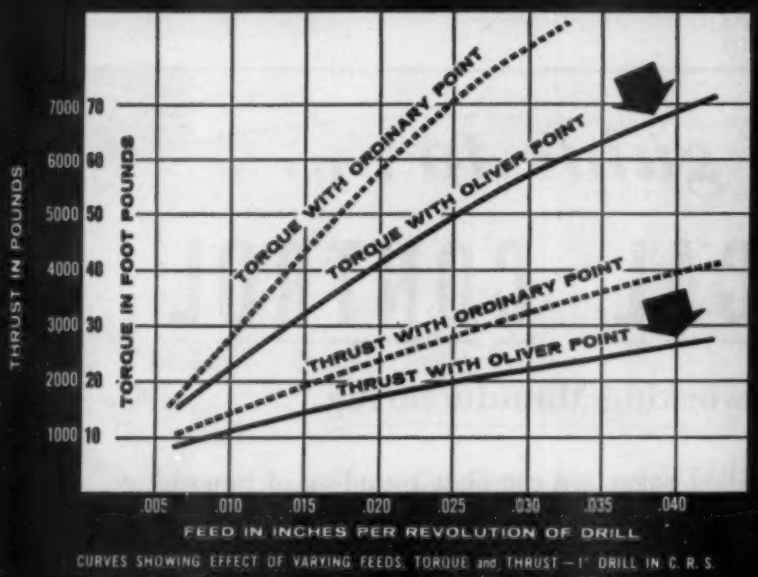

CURVES SHOWING EFFECT OF VARYING FEEDS, TORQUE and THRUST — 1" DRILL IN C. R. S.

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Substantially less torque—much less thrust!

The above graph is a typical test run by the research department of an eastern engineering school. It is evidence that Oliver can help you get more and better holes per grind.

Oliver's sharpening principle is to grind the drill point so that increased clearance is obtained at the center of the drill. Each lip does its equal share and the theoretically perfect point permits easier penetration. Less feeding pressure means savings on drilling machine repairs, power and transmission costs and the drills themselves. *The Oliver point has been successfully used since 1921.*

Oliver drill pointers are rugged enough to stand up to every day pounding. Features of the Model #510 include: a universal chucking head which holds drills from ¼ to 3 inches in diameter and swivels to give varying angles from 82 to 160°; an adjustable cam to give a variable amount of clearance at the cutting edge; and a positive drive to the chuck. In addition, all main shafts—including the grinding wheel spindle—are mounted on anti-friction bearings.

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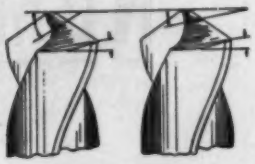
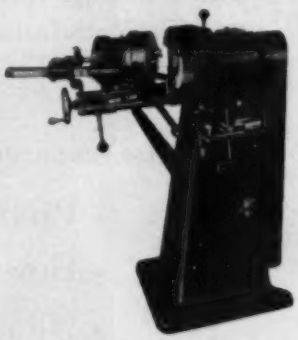
HOW TO REDUCE YOUR TWIST DRILL COSTS

Any substantial reduction in drill costs must be made by choosing a combination of the right drill design *and drill point.*



The sketch above shows a comparison of two drill points. The one on the right is as ordinarily ground. On the left is an exaggerated view of an Oliver drill point. Note that the clearance angle on the point increases very rapidly as the drill web is approached.

It is a widely accepted fact that for a given feed the angle of helix of the feed is greater as it approaches the center. It is this reason that makes increased clearance at the center of the drill point so essential. The Oliver pointers provide average thrust reductions of 25.2% and average torque reductions of 22.0%.



The Oliver 510 makes possible the trouble free grinding of drills—whether 2, 3 or 4 flute. Variable included point angles and clearances are easily obtained.

This cost-saving point is also available by using the new heavy-duty #21 bench model machine. Capacity is

3/32" to ½". A 5" diameter cup wheel and a built-in diamond dresser provides for easy operation regardless of drill size or included angle.

Heppenstall Forgings meet rigid specifications of world's largest Klystron project

When an important military radar program needed a large power amplifier, Varian Associates were asked to deliver one in record time. For the precision forgings required–delivered on time–Varian turned to Heppenstall. In a record-breaking five months, a successful prototype of the VA-842 Klystron was delivered to the Transmitter Manufacturer. In the company's words, "The speed and efficiency of the VA-842 program was due almost entirely to the complete cooperation between all areas of the company and outside contractors." *For delivery and dependability . . . why don't YOU investigate Heppenstall Forgings!*

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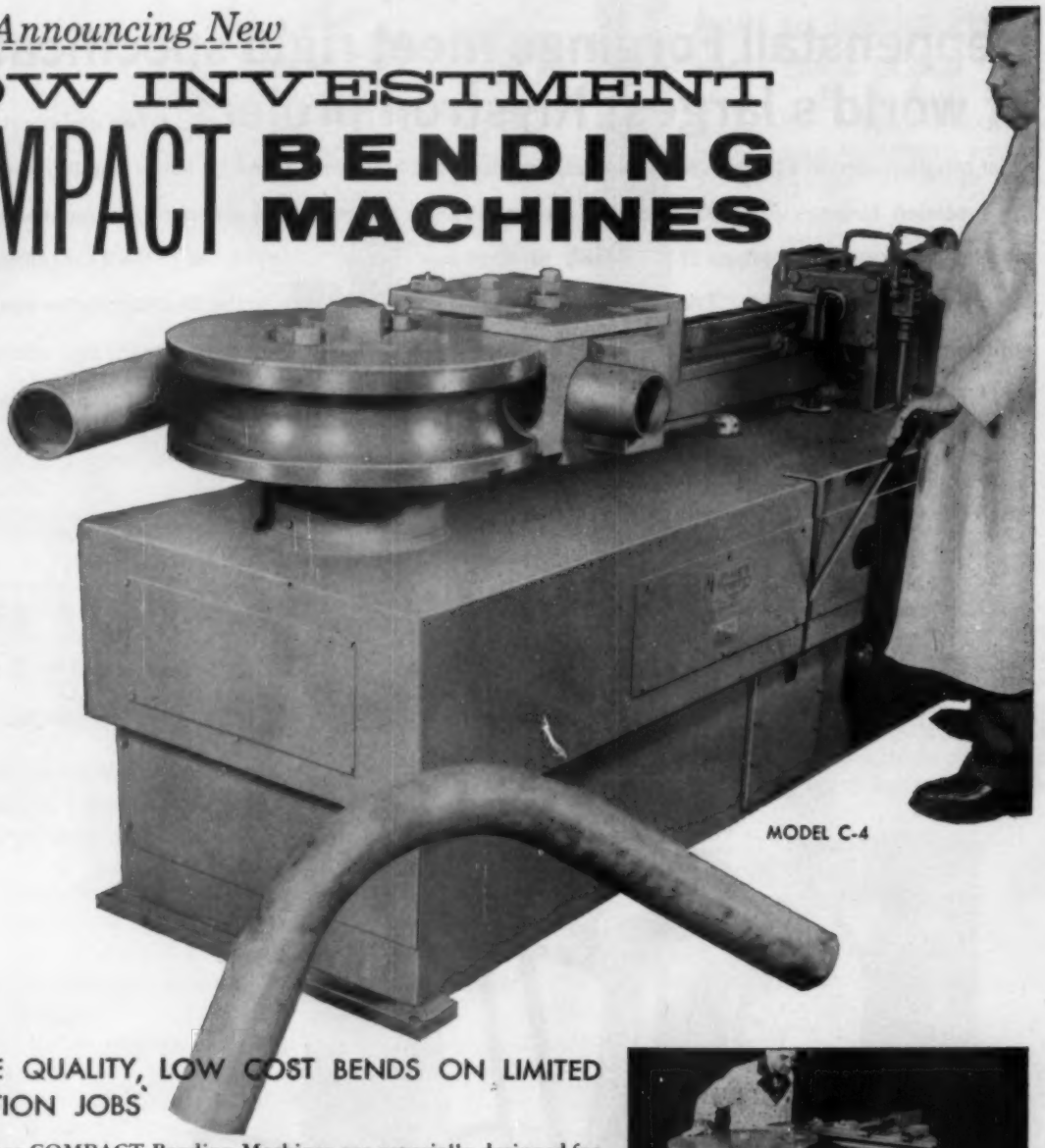


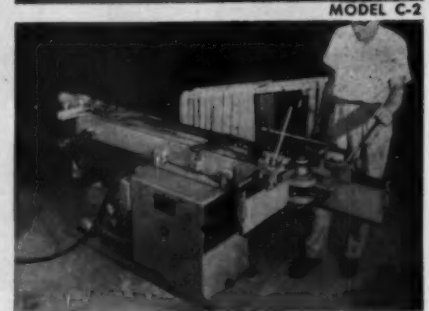
MODEL C-4

PRODUCE QUALITY, LOW COST BENDS ON LIMITED PRODUCTION JOBS

The new Pines COMPACT Bending Machines are especially designed for low production jobs, one-of-a-kind or experimental parts, maintenance or similar work where the high output of other Pines machines is not necessary. Representing a low initial investment, COMPACT machines are easily and inexpensively tooled to bend structural shapes, solid stock, and rolled or extruded sections as well as pipe and tubing.

Light in weight for practical portability and simplified in design for maximum ease of operation and set up, this complete line of machines incorporates rugged construction and hydraulic operation to assure good quality bends with close tolerances at low cost. Find out how COMPACT Machines offer a practical answer to quality limited production bending.

MODEL C-2



MODEL 1400

MODEL C-4	MODEL C-2	MODEL 1400
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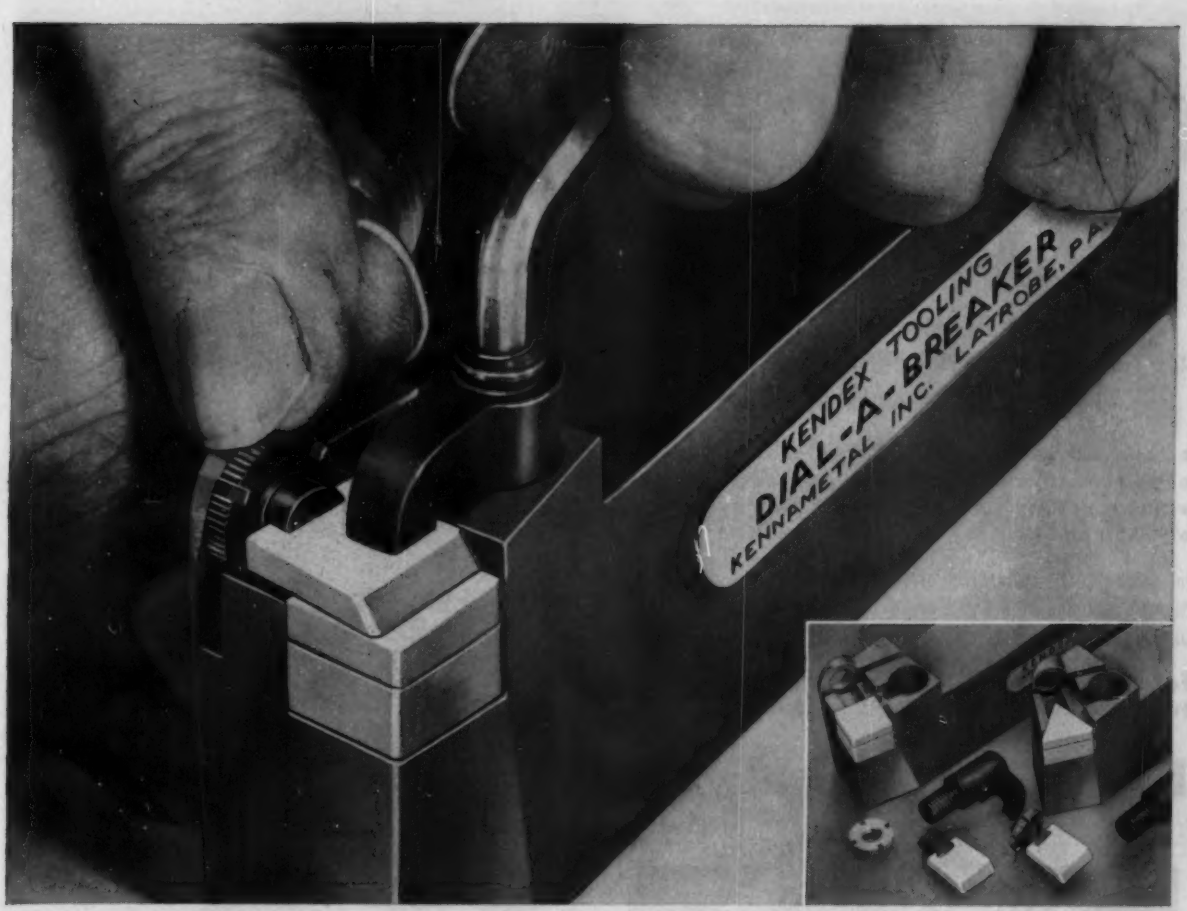

Easy adjustment, regardless of tool position. Just release the clamp and "dial" the breaker to any position desired.

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Timesaver . . . and profit maker

Chipbreakers may seem to be a trivial expense item. But final inspection of your profit on a job may prove otherwise. First, consider how much your machines and operators cost you every working minute. Then consider the fact that you are actually *losing* that much for every minute of downtime while making chipbreaker changes and adjustments to get proper chip control on every job. Add to this your daily grinding cost to maintain and modify chipbreakers. When you multiply this daily cost by the number of working days in the year . . . you may discover a serious *profit leak*.

With the Kendex Dial-A-Breaker, you can turn much wasted time into profitable production. The chipbreaker can be quickly adjusted for efficient chip control over a wide range of jobs by merely turning the dial. The chipbreaker setting is retained while changing inserts, since the chipbreaker is brazed to the adjustment screw. It can't fall out! And two sizes of chipbreakers service 70 styles and sizes of Kendex holders, eliminating the need for a different chipbreaker on every job . . . and the expense of grinding chipbreakers.

Kendex Dial-A-Breaker Holders accommodate the same solid Kennametal shims and "throw-away" inserts that are used in standard Kendex holders. Square and triangular inserts are stocked in positive and negative rake.

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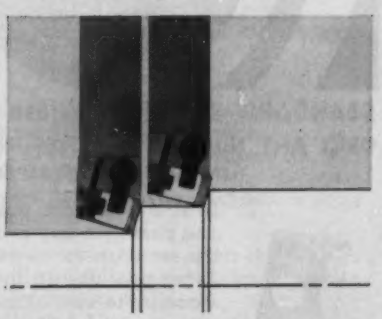

Kendex Dial-A-Breaker design permits close ganging of tools. All adjustments, chipbreaker and insert, can be made from the top of the holder.

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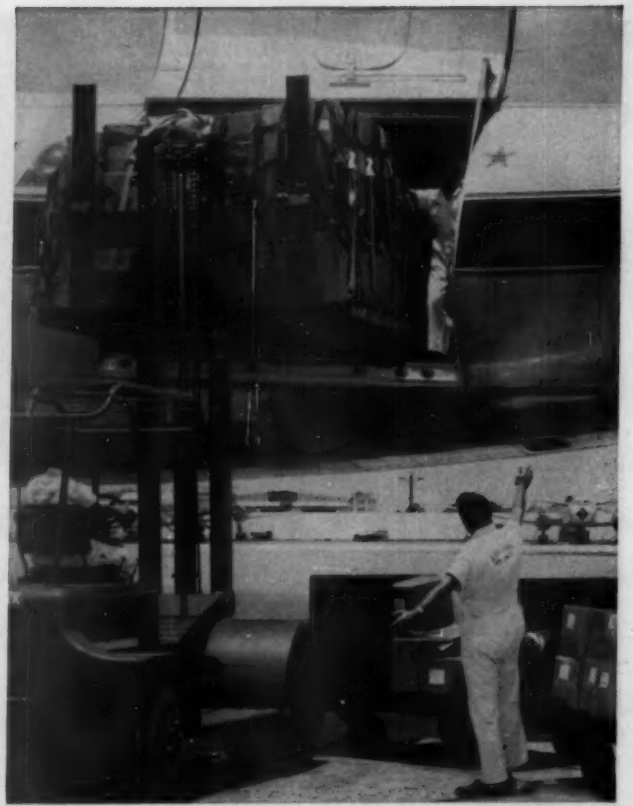

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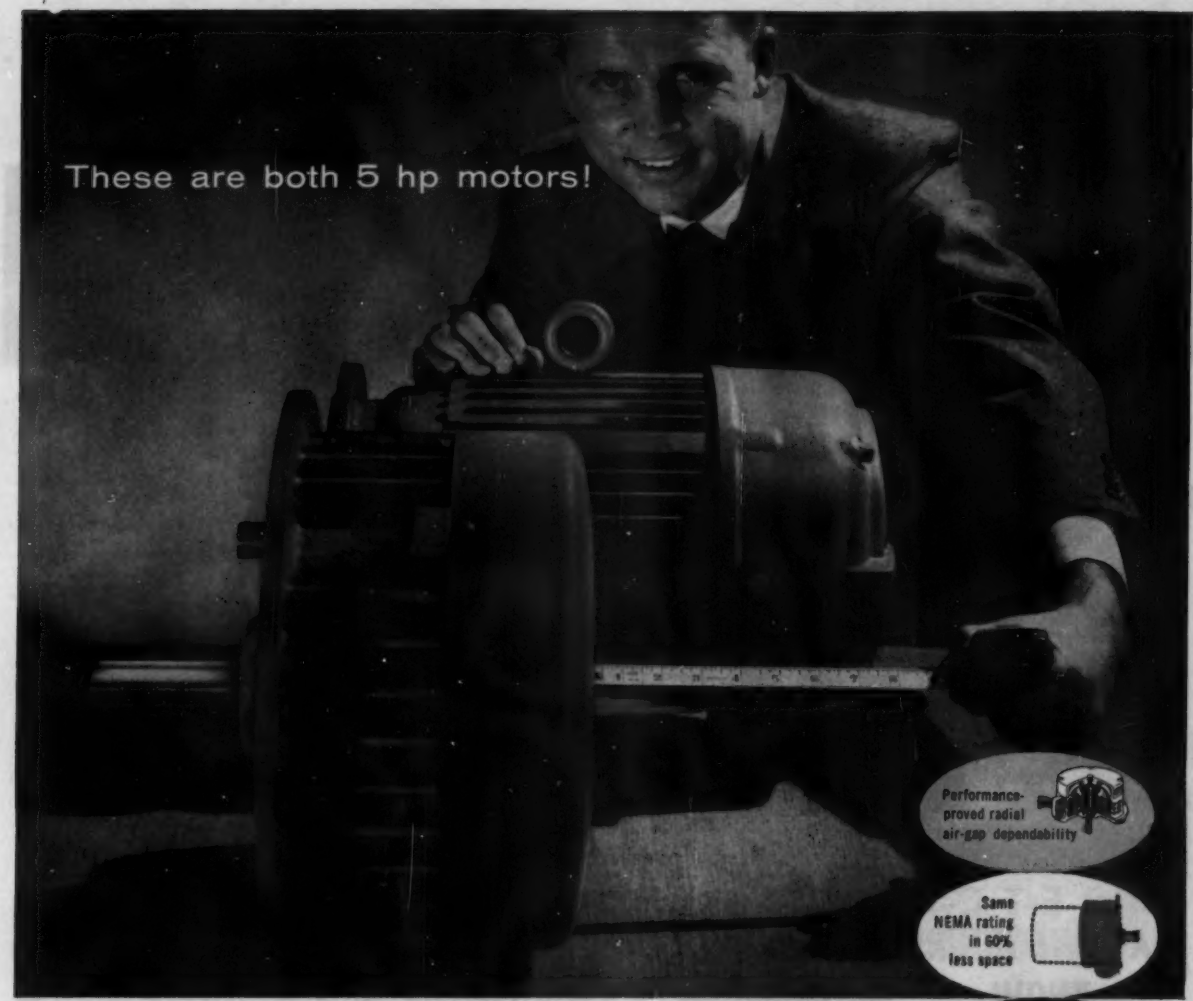

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What's more, this is achieved without sacrificing a single desirable characteristic: the stator still contains the same iron and copper as standard Louis Allis motors . . . standard NEMA service factor is maintained . . . high insulative values are retained by using proved Louis Allis varnishes and new insulating techniques . . . over-sized pre-lubricated bearings are used to guarantee long bearing life . . . and the entire motor is enclosed in an industrial-type cast-iron housing designed to shrug off abuse!

SM-181

The housing and flange are cast in one piece: this permits extra-accurate internal machining which extends bearing life and reduces noise levels to a new low.

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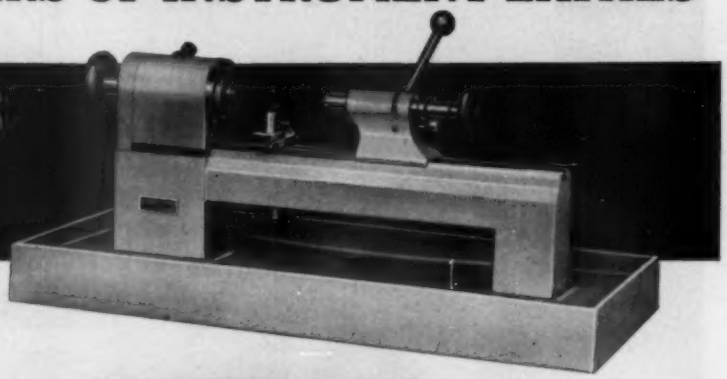

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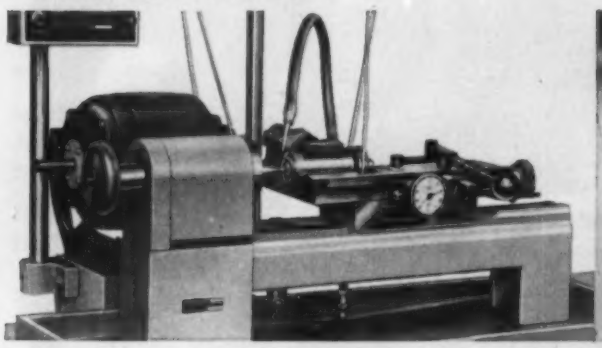

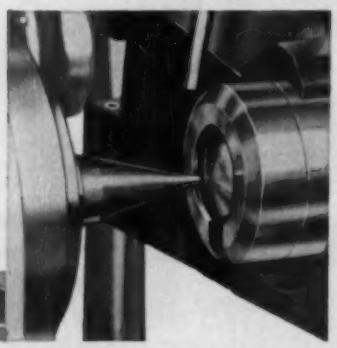

Here is a typical example of work which can be done in the new Levin ½" capacity lathe. A hole .002" in diameter is being drilled in a nozzle.

Send for literature describing the ½" capacity instrument lathe and accessories.

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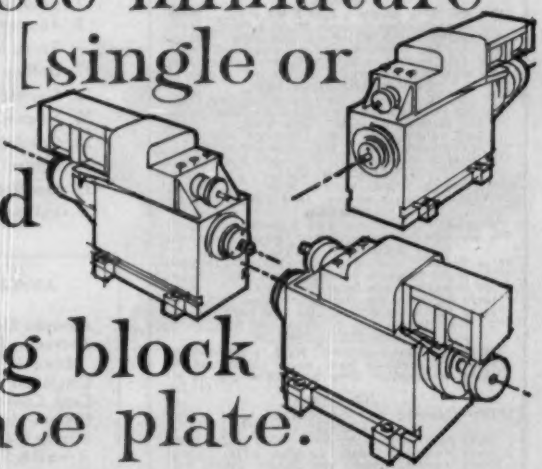
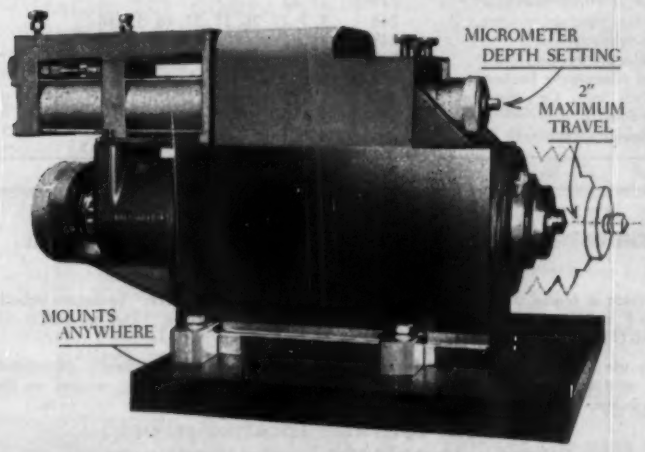
YES, A SEVERANCE MIDGET MILL MAY WELL SOLVE YOUR PROBLEM AND SAVE YOU MONEY, IF YOU MUST REMOVE GATES, FINS, AND RISERS; BREAK SHARP CORNERS AND EDGES; MACHINE CARBON; FINISH CASTINGS OF ANY MATERIAL; WORK FILLETS, RADII, AND GROOVES; DEBURR OIL HOLES; BLEND WELDED AND ASSEMBLED PARTS; REMOVE FLASH; SMOOTH WELD BEADS; OR ANY OTHER SIMILAR OPERATIONS
MANY STANDARD SHAPES & SIZES TO CHOOSE FROM
SPECIAL SHAPES & SIZES AVAILABLE ON SHORT NOTICE
SEVERANCE MIDGET MILL SET NO. 77
SEVERANCE MIDGET MILL SET NO. 77 IS A POPULAR SET OF 1/2" DIAMETER, 1/4" SHANK, HIGH SPEED MIDGET MILLS. MAKES A FINE GET-ACQUAINTED-SET AND WILL COVER A BIG MAJORITY OF YOUR NEEDS FOR THIS TYPE TOOL. LEAFLET NO. 651 GIVES DETAILED INFORMATION AND PRICES. ASK FOR IT TODAY!
Severance TOOL INDUSTRIES INC.
726 Iowa Road • Saginaw, Michigan
CARBIDE HAND FILES
REGRINDING
INSIDE DEBURRING CUTTERS
OUTSIDE DEBURRING CUTTERS
HAND DEBURRING CUTTERS
TUBE END DEBURRING CUTTERS
COUNTERSINKS & COUNTERBORES
SPECIAL CUTTERS
MICRO-MILLS & BORE-MILLS
BALL SEAT REAMERS

CIRCLE 437 READER SERVICE CARD

CIRCLE 438 READER SERVICE CARD

For instrument and small-parts industries: complete miniature boring spindle [single or multi-directional] can be assembled with this unit as a basic building block applied to a surface plate.

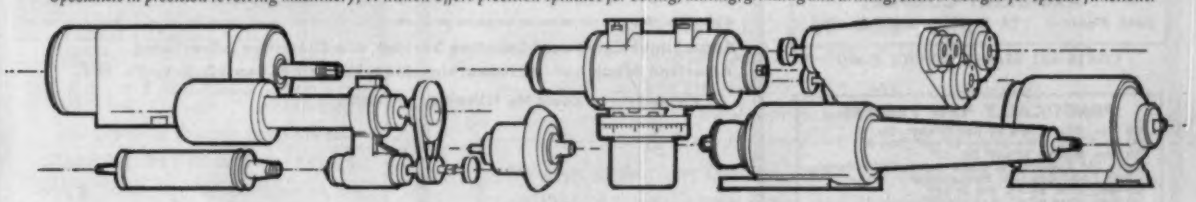




Whitnon

Reciprocating boring spindle, with fast infeed, controlled boring feed, and dwell time all precisely variable • Rotational error is less than .00003" (30 millionths) • Micrometer depth control repeats to within .0002" • Travel error less than .00005" (50 millionths) in the entire 2" maximum travel. For all industries which need precision miniature boring *plus* quantity production, this new Whitnon spindle bores at speeds of 1000 to 15,000 rpm, with every detail of its performance under precise control. Modifications to suit particular functions can be provided, as well as alternate drives and mounting details. Further information, performance data, and consultation are available — no obligation.

Specialists in precision revolving machinery, Whitnon offers precision spindles for boring, milling, grinding and drilling, custom designs for special functions.



THE WHITNON MANUFACTURING COMPANY, ROUTE 6 AND NEW BRITAIN AVENUE, FARMINGTON, CONNECTICUT

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OFFERS "GUARANTEED" MACHINE TOOLS—

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RCG = Reconditioned—Guaranteed
*Indicates 1940+ Model **Indicates 1950+

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*3½"—6 spdl Cosmatic w/Thrdg. RBG.....$14,900.

BORING MILLS
*24" Bullard VTL w/Side Head RBG.....$4950.
*24" Bullard "Cutmaster" VTL Excel. RCG $67,500.
*4 Sellers Horiz. Tbl. Type (1942).....$16,500.

DRILLS
*20" No. 20¼ Barnes 1 Spdl 3 MT P.F.....$1750.
*21" Cinc. Bickford T. Room Model 3 HP.....$1950.
*25" Sibley No. 5 MT, P.F., 1080 RPM.....$2950.
*25" No. 282 Barnes 4 MT, Air feed 3 HP $2750.
*28" Avey 28MA6 w/Deep Hole Attch.....$2450.
*28" Colburn No. 4 MT, P. ops. 10 HP.....$2750.

DRILLS, MULTIPLE SPDL.
*8" Spdl 28 No Baker, Hydr., 4 MT 15 HP $1650.
*2 Spdl 20½ Barnes 3 MT (2) 3 HP Mtrs...$2950.
*2 Spdl Delmace No. 5 MT, Hydr Feed.....$695.
*3 Spdl Foedick 4DM, 2 MT (3) 1 HP Mtrs $2250.
*4 Spdl Foedick, 4DM, 2 MT, (4) 1 HP Mtrs $2950.
**24 Spdl H-6 Natco Drill & Tapper, Hydr...$6450.

DRILLS, RADIAL
*4'x11" Amer. "Hole Wizard" RBG.....$7450.
*5'x11" Carleton, 4 MT Ser. IA1418 RBG.....$8450.

BROACH
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**6 ton—54" Colonial Hydr Ser 12084.....$3950.

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**180 Sheffield, Multiform (1957) Like New $18,500.
*272 Heald Sizematic Internal (1955) RBG $12,500.
*100 Bryant Int. New Spdl. (1947) RBG.....$6950.
**10x24 No. 4BGI Van Norman 15° Head '58 $13,500.
**36x48 Landis CHW Univ Like New 1962...$10,000.
*52 Cinc. Cutrix, Hydr Profile Dresser RBG, $4950.

GRINDERS, SURFACE
*30x36x120" Thompson Horiz. Hydr. (1943) $10,500.
*30x36x72" Thompson Hydr Horiz (1945)...$19,500.
*18x96" Hanchett V. Roty Head, Mod 400, 40 HP $10,500.

JIG BORER
*1880 Cleerman, R&I Ser CJB187.....$10,500.

LATHES
*18x30 Reed Prentice, T. Attch Thrdg (1948) $2950.
*18x96 Monarch H. Ways, T. Attch (1948)....$8950.
*24x72 Axelson, Chucks etc. 20 HP (1949) RBG $10,500
*24x96 LeBlond H.D., T. Att. Chucks (1942) $5450.
*30x96 Niles "Timesaver" T.A. 3J, 4J RBG $8850.
*74" Star "T" Lathe, 15 HP Like New.....Offers
**30H Bullard Manatrol 3 Spdl. Ser. 28164...$9900.

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*No. 3 Gisholt, Barfead, 1948, Excel.....$4050.
*No. 4 W&S Precisetor, Air Chucker (1942) $4850.
*No. 4 W&S Precisi, Hydr Barfeed (1957)...$14,500.
**No. 5 J&L, Hard. Ways, Acces (1951).....$9250.
**3A W&S with Access. 1952.....$16,500

LATHES TRACER
**20x72 Monarch Tracer, Thrdg., etc. RBG $15,000.
**32x96 LeBlond Hydro Trace (1959).....$29,500.

MILLS
**&E30 Mammut (German) Horiz. (1953).....$3950.
**#4 Cinc H.S. D.T. Vert Mill (1951).....$17,500.
**V-20 Mammut (German) Vert. H.D. Univ...$5850.
*2H K&T Vert 1400 RPM, 5 HP RCG.....$5850.
**32—2448 Sundstrand Rigidmill 15 HP '52...$12,500.
*33—1448 Sundstrand 600 RPM (1944).....$5450.
*34—48 Cinci. Hydrom., R & F Tracer, RCG $4650.
*36x96 Cinc. Hydrom., Simplex RCG.....$5850.
*28-60 Cinc. I Spdl Vert Hydrotel, RCG...$11,500.

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5'x5'x14' converted planer type, Rblt. Cond. $7500.
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*20" DoAll Vert. Bandsaw W/Welder RBG $2450.
**96" DoAll H.S. Vert. Band., Hydr. Tbl (1958) $3250.

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**75 KVA Quincy Spot 3 phase w/controls....$4250.
**75 KVA National Circular 18" Thr 440 V $2750.
**100 KVA Thompson No. LS8, Longitudinal $3450.

"MIDWESTERN"
MACHINERY COMPANY
2848 Pleasant TA 5-4461 Mpls 8, Minn.

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825 tons, Bliss #86½-60 Bed 80"x54", Str. 8"
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250 tons, Minster 84"x48" Str. 12"
Warco 600 Tons Double Crank Bed 180"x84" Double Roll Feed, Uncoiler, Straightener
135 tons, Bliss #6-48, Bed 48"x30"
100 tons, Bliss #3-36, Bed 36"x20"
75 ton Minster Pinconnector Model #P-2-75-86
Bliss #6150 High Speed Double Roll Feeds
Bliss 6458, Bed 48"x18", Str. 4"
LeBlond Engine Lathe, Type NK, 36" swing x 27' centers, 2 carriages
Practically New Leavy Hydraulic Triplex Pumps equipped with Westinghouse 500 HP motors, Farrel Sealed Gear Cases, and starting equipment

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Listed below are used, surplus new and rebuilt machine tools or services as advertised in this section.

The numbers after the advertiser's name indicates the products or services offered by the advertiser.

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7. Boring Mills
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This service is aimed at helping you, the reader of "SEARCHLIGHT," to locate rebuilt and used machine tools and equipment, not currently advertised. (This service is for USER-BUYERS only.) No charge or obligation.

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TITLE.....COMPANY.....

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11/28/60

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You can do your contour cutting and duplicating work . . . automatically. Practically any contour can be accurately reproduced on a production basis. These brand new units consist of an electronic supply, an operator's control box and a stylus. Manufacturer's price . . . $1,600.00.

Our SPECIAL Price..... **$695.00** FOB—NYC

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MONEY BACK GUARANTEE—LATE MODELS
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3000 Ton Clearing hydr. press, bed 56"x48", 250 HP self cont. hydr. system, very fast, mfg. 1943.
1300 Ton Nat'l. 'Maxipres' Forging Press, 10" stroke, air clutch, 80 SPM, 75 HP, mfg. 1955
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750 Ton Nat'l. #3 "Maxipres", 10" stroke, air cl., '42
440 Ton Bliss-Tol. #59½, bed 41"x48", stroke 12", air clutch, air cushion
235-Ton Bliss #208, bed 36"x54", stroke 8"
150-Ton Cleve. #30-D-84, 80"x40", str. 14", 32 SPM

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WENDER PRESSES, INC.
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WRITE FOR LATEST STOCK LIST
MILES MACHINERY COMPANY
3039 EAST GENESEE • SAGINAW, MICH. PL. 2-3105

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BRAKES PRESSES SHEARS
Will Lease or Furnish Long Terms
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DECIMAL DRILLS
DRILL BLANKS
REAMER BLANKS in
Steps of .001"
HAYDEN TWIST DRILL SALES CO.
25205 Ryan Rd., Warren, Mich.

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NEW MOREY No. 2 TURRET LATHES
AT TREMENDOUS DISCOUNT!!

Because we were fortunate enough to negotiate with the U.S. Government for the repurchase of a pool order standby lot!

MOREY #2 Ram Type Turret Lathes; Power feed to turret. Capacity, round 1"; turning length 6"; swing over bed 14"; swing over cross slide 6"; dia. of hole through spindle 1-9/32"; spindle nose A-1-5; spindle speeds infinitely variable from 60 to 2000 RPM; turret slide travel 6". Equipped with combination lever and screw feed, cross slide, front and rear tool posts, collet chuck, bar feed with chuck, stock feed, outer bar support, stock stands, motor driven coolant pump, 3 HP 3 phase 60 cycle 220/440 volt motor and complete electrical starting equipment.

NEW COST—
over $9,000.00 each

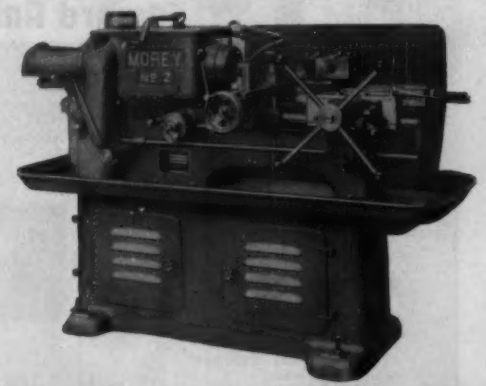
SPECIAL PRICE
$3,250.00 each
F.O.B. our Plant, Astoria, New York

25 AVAILABLE

These machines are offered with tooling of your choice, up to $1,000.00 worth, at 50% off list price, provided we have them in stock on our shelves.

THESE ARE NEW MACHINES — WITH A NEW MACHINE GUARANTEE!!

PLUS 2,000 HIGH GRADE MACHINE TOOLS.
WE SOLICIT YOUR INQUIRIES.



MOREY ...for machine tools!

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Manufacturers • Merchants • Distributors
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ALGONQUIN 4-6550 • CABLE ADDRESS: WOODWORK, N.Y.

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GOVERNMENT OWNED EQUIPMENT
"SKIN MILLING MACHINE"
SEALED BID SALE #C-15-61 (AM)

Manufactured In 1953 By Giddings & Lewis Machine Tool Co.
Model SKM — Serial No. 7694
72" Wide Table x 26' Long x 48" Height Under Cross Rail
Hydro Electronic Planer Type With Related
Accessories Including: Catwalk, Rolling Control Station, Motors, Controls, Etc.

CONDITION: USED — GOOD — ACQUISITION COST: $336,477
To Be Sold "As Is, Where Is"

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WAtkins 4-5000 EXT. 724

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Tooling is New Government Surplus • Reconditioned

TURRET LATHE TOOLING

Everything in machine shop supplies from one dependable service . . .

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Rebuilt Machine Tools

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No. 16CR 16" Bryant, m.d., latest
No. 16—22" Bryant, m.d., latest
No. 16—36" Bryant, m.d., latest
No. 16-A—29" Bryant, m.d.
No. 24—36" Bryant Hole & Face Type, m.d., late
No. 24-P—29" Bryant, m.d.
No. 24—21" Bryant, m.d.
No. 24-L—36" Bryant, m.d., late
No. 24-LW—36" Bryant, m.d., late
No. 648—16" Van Norman Automatic Oscillating Radius, m.d., latest
No. 70A Heald, m.d., latest, 1945
No. 72A3 Heald Feli Universal, m.d.
No. 72A3 Heald Gagematic, m.d.
No. 72A3 Heald Plain, m.d.
No. 72A3 Heald Plain Sizematic, m.d.
No. 72A5 Heald Plain, m.d.
No. 78 Heald Airplane, m.d., latest, new
No. 74 Heald Long Base, 1945
No. 84 Heald, Plain Long Base, m.d., 1943
No. 74 Heald, m.d.
No. 75A Heald, m.d., latest
No. 81 Heald Gagematic, Sizematic, m.d.
No. 81 Heald Plain & Sizematic, m.d.
No. 81 Heald Sizematic, m.d., 1944, cheap
No. 104 Rivett, m.d.
No. 172 Heald Plain Adjustable Gap Hydraulic m.d.
No. 112YE Bryant, m.d.

PLAIN CYLINDRICAL GRINDERS

No. 5 Brown & Sharpe, Plain, m.d., 1942
No. 20—10x18" cap. Brown & Sharpe Plain, m.d.
6x15" Cincinnati Plain Hydraulic, m.d.
6x18" Landis Type C Hydraulic, m.d., late
8x18" Norton Plain Grinder, m.d.
10x18" Cincinnati Plain Hydraulic, Model Er, m.d. Filmatic Spindle, 1943
10x18" Norton Type C, m.d., latest
10x36" Cincinnati Hydraulic, model EA, m.d.
10x36" Norton Type C, m.d.
10x36" Landis Type CH Plain, m.d.
10x48" Cincinnati Model ER Plain Hydraulic, m.d.
10x72" Landis Hydraulic, m.d.
14"x36" Landis, Type C, Plain
16x36 Cin. Plain m.d.

THE EASTERN MACHINERY CO
1004 Tennessee Avenue, Cincinnati 29, Ohio
MElrose 1-1241 CABLE ADDRESS EMCO

CIRCLE 612 READER SERVICE CARD

7'12" American Radial, Late
#3 and #4 Kling Friction Saws
4"x18" Cinc Pl Grinder, 12/55
M2½ Yoder Roll Former 11 stand Flying Cutoff
#5H K & T Plain Mill, Late
48"x19' c American Lathe, Late
¼" Kane & Roach Shape Straightener
27"x22' c Niles Lathe, Late
Send for our complete listings.
COOK COUNTY MACHINERY COMPANY
1036 W. Lake Street, Chicago 7, Illinois

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MOTORS • GENERATORS
TRANSFORMERS
NEW • REBUILT
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WORLD'S LARGEST INVENTORY
CALL COLLECT CL 4-9058
P O BOX 51 • ROCHESTER 1, N Y

Cimco

72" x 72" x18' Cincinnati Hypro Double Housing Planer, new 1943, 4 heads, pneumatic tool lifters.

90" x 90" x 20' Cincinnati Hypro Double Housing Planer, 4 heads, pneumatic tool lifters, late.

6'15" column American Helowizard Radial Drill column extended 2', 32 speeds, late.

14' x 12' x 30' Betts Double Housing Planer, 50 HP DC motor, 4 heads, box table, ACTUAL PHOTOGRAPH AVAILABLE.

16" x 40" x 90" centers Norton Type "C" Cylindrical Grinder, two gaps, swing 40 x 29" in gaps, mechanical feed, late type.

22" x 24' centers Monarch Model CM Geared Head Lathe, actual swing 27½", 16 speeds, two Carriages, tapers.

Model 300 Hanchett, 13 x 48" table, complete with magnetic chuck and rectifier, late type.

24" x 72" Sidney G.L. late, 16 speeds, Timken bearing, taper attachment.

18" x 48" Thompson Hydraulic Surface Grinder, late type, AC motor.

4A Warner & Swasey Saddle Type Turret Lathe, 24" 3 jaw chuck, 8¼" hole in spindle.

#32 Williams & White Multiple Punch, double crank, double geared.

1500# Chambersburg "Coco" Drop Hammer, 42" stroke.

Cincinnati Machinery COMPANY

3901 Kellogg Ave., Cincinnati 26, Ohio
Phone TR 1-0853

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CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITION VACANT

Design Engineer—with degree in mechanical engineering—5 years experience in the design of dimensional gaging equipment for metalworking industry. Should be familiar with mechanical, electronic and pneumatic gages and their application to specialized gages, machine control and automatic gaging. New England location. Salary commensurate. P-5659, American Machinist.

POSITION WANTED

Mechanical engineer, 28, single, trained machinist, 4½ years experience designing textile and welding machinery, working knowledge of English, **seeks** employment as design engineer. Please write to Ga.A. 10 889 c/o. Carl Gabler Werbegesellschaft MBH, Augsburg, Grottenau 2, Germany.

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NOW another Hammond FIRST!

Introducing...

VARIABLE SPEED Automatic

Polishing and Buffing Heads

Hammond Dial Control Does It!

Advantages

...Select proper wheel speed while head is running ...Various speed ranges available

1 — WHEEL ECONOMY: As wheels wear speed is increased, giving maximum production and wheel life.

2 — INCREASED PRODUCTION: Select most efficient speed without stopping head.

3 — BETTER FINISH: Different materials require different speeds.

4 — CONVENIENCE: Metal chart on dial is your guide to the right speed for the job.

Write today for complete information!

Hammond Machinery Builders INC.

1618 DOUGLAS AVENUE — KALAMAZOO, MICHIGAN

CIRCLE 441 READER SERVICE CARD

ELGIN Ultra-Universal Tool & Cutter GRINDER

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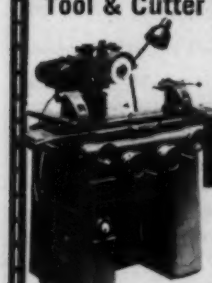

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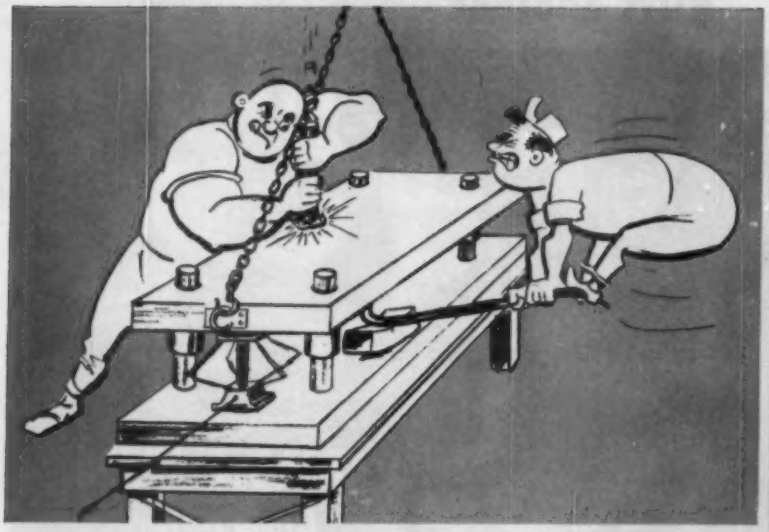
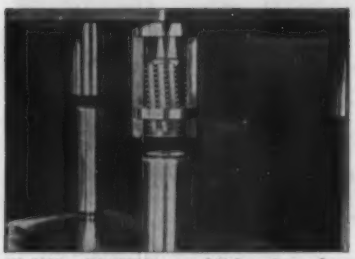


Dieco Ball Bearing Die Sets take all the strain out of die making!



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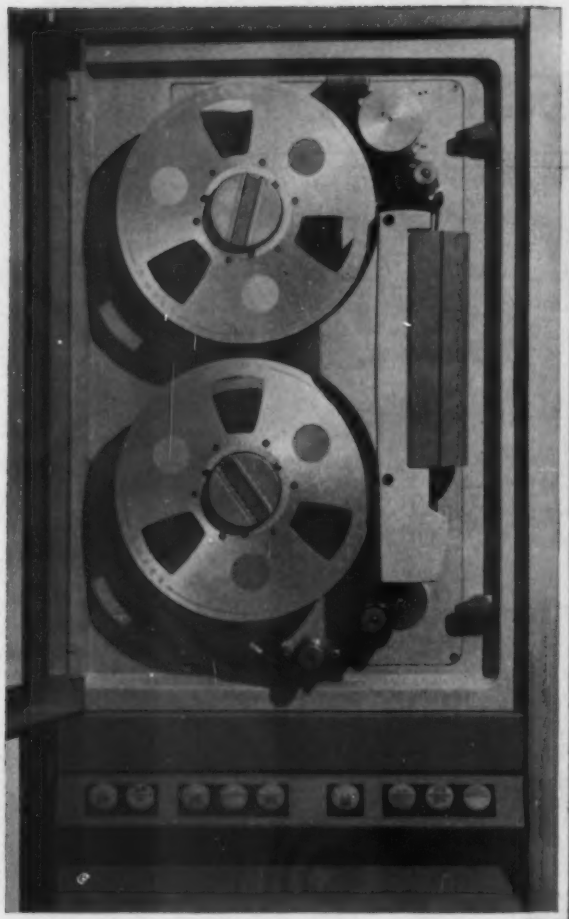

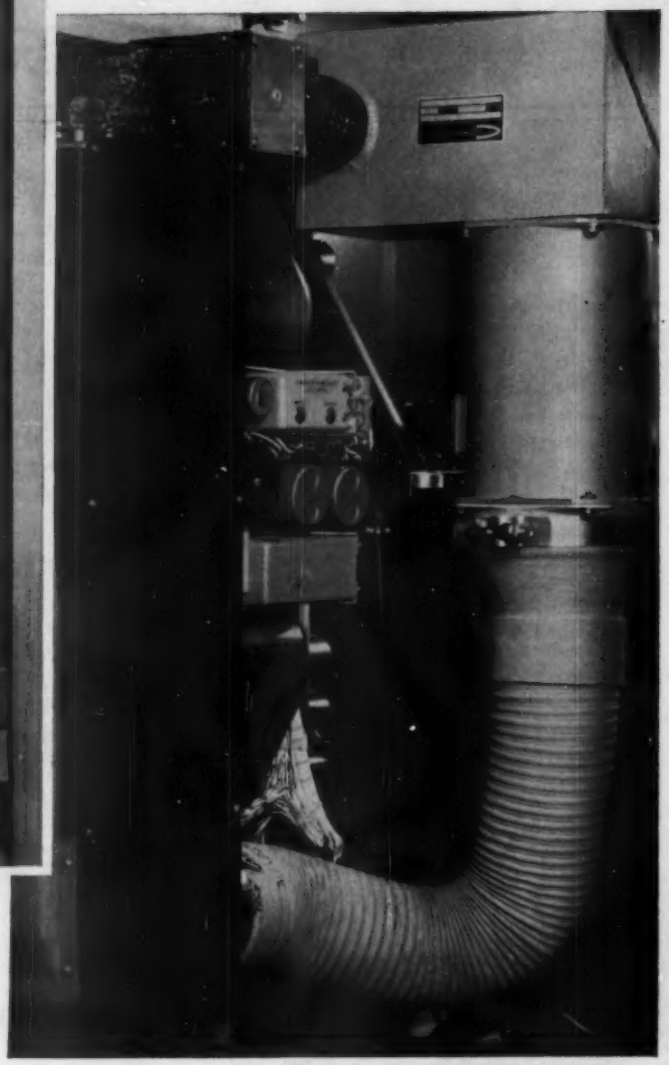

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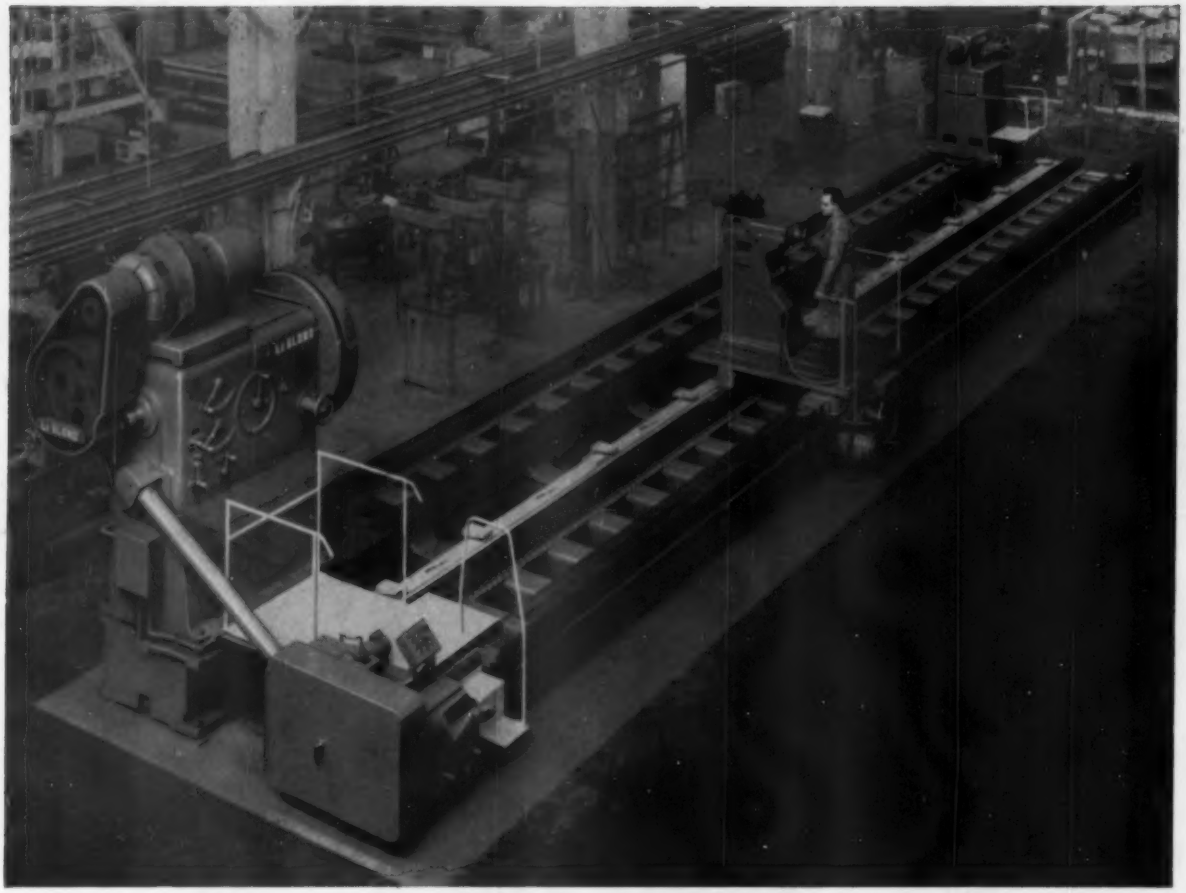

First U.S. double-bed lathe... Le Blond's huge "Admiral"... assures spindle rigidity with Timken® bearings

IT'S a giant! . . . this lathe built by R. K. LeBlond Machine Tool Co. Named the "Admiral", it's the first U.S.-built double-bed lathe. And it weighs 75 tons, is 54 ft. 6 in. long, 120 in. wide. To maintain spindle rigidity under 50,000 lb. line load, Le Blond mounts it on Timken® tapered roller bearings. And for extra quality, the lathe ways are made of Timken 91140 steel. Le Blond uses Timken bearings to get:

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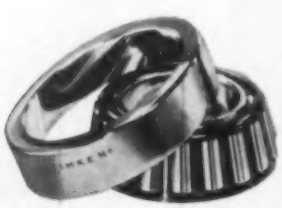

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